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LIGHTNING.

Probably no one in this country has had more opportunity to study lightning and other similar phenomena and their effects upon electrical plants than Dr. Charles P. Steinmetz. He has several times discussed that phase of the subject which relates to the protection of electrical systems from those disturbances which are to-day classed as lightning, even though they may arise within the system itself. Nevertheless, the recent address which he delivered before the National Electric Light Association at the convention in Washington, D. C., is well worth careful study.

The first portion of this address is of much scientific interest, because in it Dr. Steinmetz attempts to bring into agreement the results of laboratory experiments and very high potentials and the observations on lighting. The cause of lightning has for some time been assumed to be the increase in potential of drops of water as they are formed by the coalescence of smaller drops. In this way, the potential of each drop increases rapidly. This accounts for the source of electrical energy, but, when it was attempted to estimate the actual potential represented by a lightning flash, using for this purpose values measured in the laboratory, it was soon realized that the high values thus indicated were improbable. For example, assuming a break-down potential of 100,000 volts to the inch in air, a lightning stroke two miles long would call for the difference in potential of 1,300,000,000 volts. Such a strain in the upper atmosphere would give rise to other effects, such as enormous brush discharges, which are not observed.

This difficulty, Dr. Steinmetz explains away by assuming that a flash of lightning does not represent a single discharge from one point to another, but is a series of discharges from point to point along the clouds, each discharge being caused by high potential difference. These differences of potential are due to the difference in the density of a portion of the clouds; therefore, these potential differences alternate in direction. A lightning flash is, therefore, a series of discharges, one following immediately after the other, each perhaps being released by the preceding one. On this assumption, he estimates that the average difference of potential between different points in the clouds is about 50,000,000 volts—that the current in a discharge is about 10,000 amperes, and the energy of the discharge is 10,000 kilowatt-seconds, or 7,000,000 foot-pounds —not so very large when converted into the form of heat; the discharge is alternating in character, as is shown above; the frequency is about 500,000 cycles. These figures are arrived

at, after considering the various phenomena from several points of view. It may be accepted until more exact and experimental evidence can be obtained.

The second portion of this paper dealt with the protection of electrical systems from lightning troubles. These troubles are divided into three classes. A high potential static strain. This may be relieved by connecting system to the ground through a high resistance. The second class consists of electrical surges, which may be due to several causes, internal or external. This trouble may be guarded against by a spark-gap arrester, which will provide a low-resistance path to the ground, and then extinguish the arc thus formed. The third class of lightning disturbances are the recurrent surges; that is, one surge following another, caused generally by a short circuit or ground on the system. These disturbances are taken care of as they come along by an air-gap arrester, but this instrument will generally be destroyed before the source of trouble is removed. Against them, some new protection is needed, and it is hoped that this will be provided by the aluminum cell arrester, which seems to be able to discharge all excess potential disturbances without short-circuiting the system, and which also is self-healing, when the potential has been restored to its normal value.

HAS TRANSMUTATION OF METALS BEEN ACCOMPLISHED?

Ever since it has been believed that radium, in decomposing, gave rise to another element, helium, many investigators have been searching for a transmutation of one element into another; but, with the exception mentioned, and the possibility that argon was formed when the radioactive element broke up, no evidence was found.

Now, it seems that the looked-for effect has been found, for, in a modest letter contributed to *Nature,* of July 18, Sir William Ramsay says that he believes he has evidence of the transmutation of copper into lithium, and possibly into other elements of the alkaline group. If further experiments confirm this conclusion, one of the most scientific discoveries has been made; for, although the younger school of physical scientists, or at least that section of it which utilizes the electron theory of matter, assumes that the elements are merely complex groups of a primal element, the electron; this theory being based on effects produced by the elements, and not on any evidence that one could be changed into another. Exception, of course, is understood with reference to the radioactive phenomena mentioned above. But it was by some similar change that the actual transmutation was expected, or at least hoped to be accomplished. Unfortunately, no means had been discovered of controlling the phenomena of radioactivity. The method which Sir William Ramsay has employed utilizes radioactive effects, and, while he does not control the phenomenon of radioactivity itself, he has found that there are means of controlling the way in which the energy is set free during the break-up of the radioactive element; and it is in this way that he brings about his changes. It is worth while to quote part of this epoch-marking letter:

"From its inactivity, it is probable that radium emanation belongs to the helium series of elements. During its spontaneous change, it parts with a relatively enormous amount of energy. The direction in which that energy is expended may be modified by circumstances. If the emanation is alone, or in contact with hydrogen and oxygen gases, a portion is decomposed or disintegrated by the energy given off by the rest. The gaseous substance produced is in this case helium. If, however, the distribution of the energy is modified by the presence of water, that portion of the emanation which is decomposed is neon; if in presence of copper sulphate, argon. Similarly, the copper acted upon by the emanation is degraded to the first member of its group, namely, lithium. It is impossible to prove that sodium or potassium are formed, seeing that they are constituents of the glass vessel in which the solution is contained; but from analogy with the decomposition products of the emanation, they may also be products of the degradation of copper."

We believe it was Arrhenius who described, some time ago, his conception of the groups of elements. He suggested that transmutation from one into another could be accomplished, but, to do this, called for large amounts of energy to carry the one substance over into the other, and he said that we had at that time no source of energy that we knew to be capable of doing this. It seems that Sir William Ramsay has found a way to accomplish this change by means of the enormous amount of energy set free during radioactive changes.

The far-reaching importance of this announcement is recognized by every one, and all will wait with impatience for a fuller description of the experiments which has been promised by Sir William.

It will be recalled that, some time ago, it was announced in the daily papers, and later contradicted, that Sir William Ramsay had succeeded in making copper. That rumor, no doubt, arose from the work which Sir William was then carrying on. The present announcement, however, is given by the discoverer himself.

There will, no doubt, be much speculation regarding this new chemical action. Indeed it is significant—one might say it was to be expected that, in transmutation, one element changes into another of the same family. In this case, copper goes over into lithium, the lightest metal of that group, when a heavy element is changed into a lighter one.

It is also noteworthy that nearly all the gaps in the periodic table of chemical elements occur at the lower end, or among the heavy elements. Some, no doubt, will be inclined to give credit to the alchemists of old, with the idea that one element could be changed into another. It is hard to see, however, how this is discerned, because the old philosophy considered everything to be made up of the four elements, earth, air, fire and water; and, if one accepts this hypothesis, the idea of changing one substance into another is at once suggested. One might as well give Verne credit for the invention of the submarine boat, or

other romances of later scientific discoveries or engineering triumphs.

There is one point in this change which is well worth bearing in mind. It is a heavy element which is degraded into a lighter. The noble metals are heavy, and we have not yet been shown how a lighter metal may be ennobled; and, even should this be accomplished, it is more than likely that the transmutation will cost more than the metal produced is worth.

THE EARTH'S MAGNETIC AXIS.

Some investigations have been made recently to determine the position of the earth's magnetic axis and the wandering of this from year to year. The latest of these investigations is given in the current issue of *Terrestrial Magnetism and Atmospheric Electricity,* by Dr. W. van Bemmelen, who deduces the position of the mean magnetic axis by means of a study of the magnetic declination alone. In the same issue, Dr. L. A. Bauer shows that if all the magnetic elements be considered, a result is obtained not in agreement with Dr. van Bemmelen's, and he then goes on to show why this is so. He first points out that Gauss's definition of the magnetic axis of the earth is the straight line about which the earth's magnetic moment would have a maximum value. If, then, the earth be uniformly magnetized, it will be possible to determine definitely the position of this imaginary line. However, not only is the magnetization heterogeneous, but it consists of two elements—internal forces and the external; and these vary independently of each other. Moreover, there is a third possible force affecting the magnetic distribution in the earth. This is magnetization caused by vertical earth-air electric current. There are therefore three elements to be considered, all of them independent, and in trying to locate the axis by means of these, different results will necessarily be obtained. In other words, the earth has three magnetic axes —one for each of the three component forces. Evidently the magnetization of the earth is a complicated phenomenon requiring for its study many and widely separated observations. This is a kind of work which appeals to but few, but fortunately it is being carried on with all the vigor that could be expected. From the surveys now being made in various countries it is to be hoped that much more will be known of it than heretofore. But it is likely to be a long time before we come to any very clear understanding of the whole phenomenon.

THE MUNICIPAL OWNERSHIP REPORT.

The final report of the municipal ownership commission of the National Civic Confederation has been made public. An abstract of this is given on another page of this issue. When earlier reports were given out, it was foreseen that these in general consisted of two independent reports, each report being prepared by an advocate of that side of the question, and it appeared that but little good would be accomplished. The public could not be expected to go through all of these reports, containing, as they do, about one million words, and the brief abstracts which were published in the daily press will throw comparatively little light on the problem. It is pleasant, therefore, to find that the commission has prepared a report in which it comes to certain definite conclusions. This is signed by the entire commission, with one exception, although two other members take exception to certain of the recommendations.

It is worthy of note that these conclusions are not at all favorable to a socialistic view, for the commission does not believe that municipal ownership of public utilities should be extended to revenue-producing industries which do not involve the public health, the public safety, public transportation, and the permanent occupation of streets or ground, and that municipal ownership should be undertaken solely for profit.

That is an excellent conclusion, provided, as Messrs. Edgar and Clark point out, it is not construed as implying that, if the public health or safety, or the other utilities mentioned, are involved, municipal operation should always be undertaken. These qualifications, it should be noted, would bring all of the more important public utilities, which is to supply water, gas, electricity and transportation, under municipal operation.

This final report of the commission will perhaps have more effect upon the municipal ownership problem than all the independent reports. It may and perhaps will discourage somewhat municipal ownership, as its cause seems to have languished of late.

A NEW DESIGN FOR HIGH-TENSION TRANSMISSION LINES.

One of the limiting features in high-tension transmission is the insulator and the means by which it is attached to the supporting structure. The line of development in this work has followed that found suitable for telephone and telegraph work, the insulating body being of a suitable shape and supported on a vertical pin. This is a simple arrangement and has some advantages, but is also not without certain disadvantages. The pin itself and the method of attachment to the structure and to the insulator are points of weakness. For this reason two papers read at the recent convention of the American Institute of Electrical Engineers, one by Mr. H. W. Buck and the other by Mr. E. M. Hewlett, attracted a good deal of interest, for they describe a system of construction which eliminates the insulator pin and makes it possible to connect as many insulator sections in series as is desired. The sections are to be made up in standard form, and the required number looped together and hung from the suspending beams attached to the supporting towers. This method of suspension also allows the cables to swing freely, and thus equalizes the strains on successive spans. The line now being constructed on this plan will, it is hoped, be thoroughly tested to bring out its capabilities. The result will be watched with a good deal of interest, because of the novelty of the method, and also because it is hoped that this type of construction will make it feasible to carry transmission voltages considerably over 60,000, the figure which is to-day practically the working limit. These two instructive papers were published in a recent issue of this journal.

CONVENTION OF THE ILLUMINATING ENGINEERING SOCIETY.

BOSTON, MASS., JULY 30-31.

The first convention of the Illuminating Engineering Society was opened at the new Edison Building, Boston, Tuesday morning, at 10.30. The meeting was called to order by John Campbell, chairman of the General Convention Committee, who turned over the chair to President C. H. Sharp.

Mr. Campbell then introduced Governor Guild, who welcomed the society to the state and expressed his appreciation of the work it is doing. He assured the members that the freedom of the commonwealth was theirs.

Following the governor, Mr. Campbell introduced Mayor John F. Fitzgerald, of Boston, who welcomed the society most heartily to the city and delivered a brief address appreciative of the work done by the engineer in controlling nature's forces, dwelling particularly upon the triumphs of the electrical engineer.

This address was followed by the presidential address. President Sharp took for his subject "The Concepts and Terminology of Illuminating Engineering," urging in this the adoption and use of several terms.

The address was discussed by V. R. Lansingh and J. R. Cravath.

This address was followed by a paper by Dr. E. P. Hyde, entitled "Primary, Secondary and Working Standards." In this the author urges that steps be taken looking to the adoption of an international standard of light.

This paper was discussed by L. Bell, P. S. Millar, A. E. Forstall, T. J. Litle, Jr., C. O. Bond, C. H. Sharp, J. E. Woodwell and J. T. Marshall.

In the afternoon the session was called to order at 1.15 and L. H. Scherck read a paper entitled "Illuminating Engineering and Central Station Practice," in which he urged central station managers to take active interest in the methods by which the current is used. There was no discussion.

This was followed by a paper by C. E. Knox on the "Illumination of the Engineering Societies Building," read by F. R. Nugent, which describes this notable installation.

This was discussed by Messrs. Woodwell, Lansingh, Marshall, F. W. Willcox, Risdon and L. B. Marks.

A paper on "The Present Status of Candle-Power Standard for Gas" was read by C. H. Stone, and was discussed by A. E. Forstall.

T. J. Litle, Jr., read a paper on "The Inverted Gas Light," which describes the inverted Welsbach mantle. This was discussed by C. H. Sharp and C. O. Bond.

A paper by A. C. Morrison on "Acetylene," in the absence of the author, was read by title.

Nelson Goodyear read a paper entitled "Acetylene Lighting," which was discussed by Messrs. Lansingh and Litle.

Dr. C. H. Williams read a paper on "A New Comparison Photometer."

This was followed by P. S. Millar's paper entitled "Illumination Photometers and Their Use."

These papers were discussed by L. Bell, G. H. Stickney, W. D'A. Ryan, J. T. Marshall and L. B. Marks.

A paper entitled "A Graphic Illumination Chart" was read by V. R. Lansingh.

The last paper of the afternoon was by P. S. Millar, on "The Elements of Inefficiency in Diffused Lighting Systems," in which figures are given comparing the efficiency of these systems with direct-lighting systems.

Discussed by L. B. Marks and J. R. Cravath.

In the evening an informal meeting was held, at which W. D'A. Ryan explained the exhibits of lighting apparatus and instruments.

Frank J. Sprague Replies to Criticisms.

At a meeting of the American Institute of Electrical Engineers, held on May 21, a discussion on electric trunk line operation took place, the subject being introduced by a paper entitled "Some Effects and Problems Bearing on Electric Trunk Line Operations," by F. J. Sprague. This paper dealt with the subject in the author's characteristic trenchant style, and provoked a sharp discussion between the advocates of the direct-current system and those of the single-phase system. As the discussion lasted until late in the evening, time was not available for Mr. Sprague to reply to his critics. This he has now done in a communicated discussion, in which he vigorously upholds the opinion expressed in his paper.

Mr. Sprague wishes it to be understood that he is not opposed to the single-phase system; that any system which makes for simplicity is to be welcomed, provided, of course, it does not bring with it more serious disadvantages.

Mr. Sprague expresses his appreciation of the work done by W. J. Wilgus in developing the New York Central system, and putting it into operation, and he agrees with Mr. Wilgus that the work of electrification should be carried out more as an evolution than as a revolution.

Mr. Sprague then takes up somewhat in detail the criticism made of his comparison between the direct-current and the alternating-current motors. He holds that in comparing two motors it is proper that the weight efficiency should be based upon two conditions: first, the total weight of the motors and connecting devices necessary to the transmission power of the motor to the axle; and, second, the total amount of the apparatus plus other devices for collecting or controlling motors which is carried upon the car.

In the comparison which he made, motors designed by the same company were particularly selected so as to avoid unjust criticism. The direct-current motor referred to is the one adopted for the New York subway, and which, slightly modified, has been adopted for a number of other important electrical roads. The other was a single-phase, twenty-five-cycle motor built by the General Electric Company for motor-car work.

Mr. Sprague then compares the New Haven single-phase locomotive with those of the New York Central system. The greater power of the latter makes it possible for twenty-three of them to do the work of thirty-five of the New Haven locomotives, and this difference in equipment is sufficient to provide for a synchronous converter equipment two or three times as high as that actually required by the direct-current system.

Mr. Sprague also believes that, taking into consideration the type of construction required for a high-tension trolley system, the cost of alternating-current system would actually be higher than that with the low-potential third-rail system, and he believes that a 1,200-volt third-rail system, if unhampered by special conditions, would be cheaper than the alternating-current system as at present installed.

Regarding the single-phase motor, Mr. Sprague states that it has a lower rate of acceleration than the direct-current motor, and that the narrow air-gap required is a disadvantage. He says that the New York Central type of locomotives can not be dismissed lightly from discussion as being but a single installation, for while this is true, it is at the same time the largest electric locomotive installation in the world. These machines are probably doing more work to-day than all other electric locomotives of trunk-line size which have been built in the United States in the past twenty years.

Boiler, Engine and Generator Testing and Management—III.

By Charles L. Hubbard.

Notes on Engine Testing.

IN the following article it is assumed that the engineer is familiar with the use of the indicator and understands working out the power of an engine from the cards. The points touched upon, while having a direct bearing upon each other, are treated independently to a certain extent; the matter presented, as the title signifies, being a series of suggestions and directions which will be found useful in carrying out a test. A short discussion upon the various forms of indicator diagrams which are illustrated, is given as a preliminary to an article upon valve setting which is to follow.

In making a test there are various things sought for, among which may be mentioned the power of the engine under stated conditions, the amount of dry steam used per horse-power per hour, the friction horse-power of the engine, and the cylinder losses from condensation, leakage, etc. In addition to these the form of the indicator diagram illustrates graphically the different events of the stroke, and is of great assistance in making a proper adjustment of the valves to secure the greatest economy of operation.

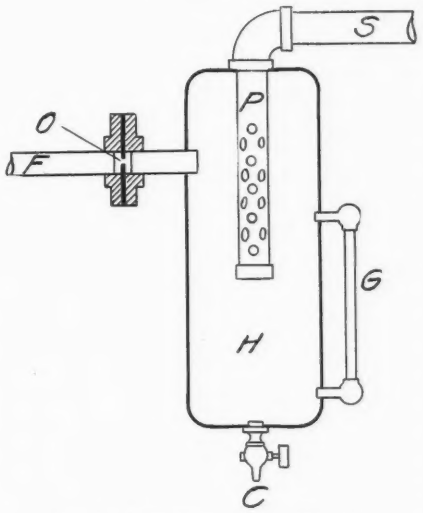


FIG. 1.—SEPARATOR CALORIMETER.

After having determined the indicated horse-power of the engine, the water-rate or weight of dry steam per horse-power per hour is easily computed; and this, taken in connection with the boiler test described in a previous article, will give at once the pounds of coal required for each horse-power generated.

In this connection it may be well to describe briefly a more accurate method of measuring the moisture in the steam than that given by the barrel calorimeter.

The separator calorimeter shown in Fig. 1 is as simple in construction as any, and gives good results when carefully used. For this reason it has won a good deal of favor, and fully justifies a detailed description. When using this instrument it is not necessary to record any temperatures, as will be obvious from the following explanation: Referring to Fig. 1, let S represent the pipe containing the steam lead in from the main pipe. The end of this pipe is perforated, and is seen to extend a little over half way down into the hollow cylinder H (a large piece of pipe). G is a water-gauge glass, and C is a cock which allows the condensed steam to be collected and weighed. It is evident that the steam rushing in through the perforated pipe will have considerable inertia; furthermore, the only outlet this steam has is through the small orifice O in the pipe F, therefore the moisture in the steam will be deposited and collected in the calorimeter, and only dry steam will escape through the small orifice. The weight of condensed steam divided by the total weight of steam sent through the calorimeter will be the percentage, or rather the fraction, of moisture in the steam.

There will be some condensation due to radiation from the walls of the calorimeter, so that it is advisable to use two calorimeters, the escaping steam of the first passing into the second. The water (condensed steam), which is accumulated in the second, will be due entirely to radiation since dry steam entered it.

Before commencing the test, steam must be run through, and the calorimeter brought up to a constant temperature. The water level in the gauge should be marked by placing a thread on the glass, and at the close of the test the water should be drawn off until this same level is reached. It is well to state here that the calorimeter—no matter what kind is used—should be thoroughly lagged with

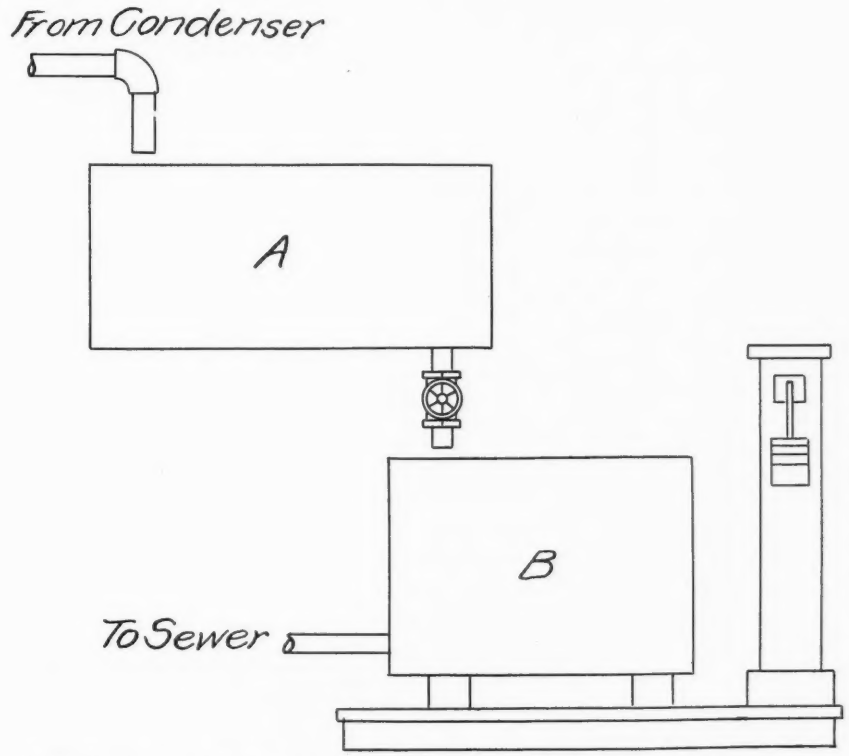


FIG. 2.—ARRANGEMENT OF CONDENSER AND TANKS FOR DETERMINING THE CONSUMPTION OF STEAM.

hair-felt or asbestos, in order to reduce the loss by radiation to a minimum.

The following formula expresses the quality of steam as found by this form of calorimeter:

$$Q = \frac{W + R}{W + w},$$

where Q = dryness of steam (expressed as a fraction);
W = weight of dry steam discharged through the calorimeter;
w = weight of water drawn off;
R = water condensed by radiation;
the latter value being found by the second calorimeter as was explained.

Practically all engines in electric power stations are equipped with condensers, and if these are of the surface type the weight of steam used by the engine can be determined by weighing the condensation delivered by the air-pump. This is a simple operation, and yet it requires careful attention and forethought. Referring to Fig. 2, suppose the condensed steam passes out into the tank A. This we may call the supply tank, and it should be of sufficient size not to overflow between readings of the test. From this tank the water is drawn off into tank B, the weighing tank.

After each reading, the weight of the tank after the water has been released must be carefully noted, and must be subtracted from the total weight. The weight of the tank will vary some because the quantity of water which adheres to it is never the same for two readings.

When making the test it is often desirable to record the amount of cooling water used in the condenser, as this is sometimes an important item. The cooling water may be weighed, and accounted for, in the same manner as the condensed steam just described, or it may be passed through a meter.

If a jet condenser is used, or if the exhaust is turned into the heating system, the weight of steam can only be determined by arranging the connections so that the steam used by the engine being tested shall be supplied by a single boiler which supplies steam for nothing else, and then weighing the feed-water as in a boiler test. Knowing the total weight of steam discharged by the engine in a given time, and its quality, the dry steam per horse-power can be easily determined.

The weight of steam wasted through the various cylinder losses may be found by subtracting that shown as being useful by the indicator diagram from the total weight supplied to the engine.

The pressure and volume at any point in the stroke may be obtained by direct measurement from the diagram, and the density or weight per cubic foot for steam at this pressure may be obtained from a steam table. The weight of steam in the cylinder at any point after cut-off may be determined by computing the volume of the cylinder or piston displacement up to the point taken, including clearance, and multiplying this by the weight of a cubic foot of steam at the pressure indicated by the expansion curve at the point taken.

This weight, of course, includes the steam remaining in the cylinder at exhaust closure and used for compression, so that in order to obtain the actual weight used per stroke this amount must be deducted.

The method of obtaining the weight of steam remaining in the cylinder is similar to that described above, except a point is chosen on the compression line instead

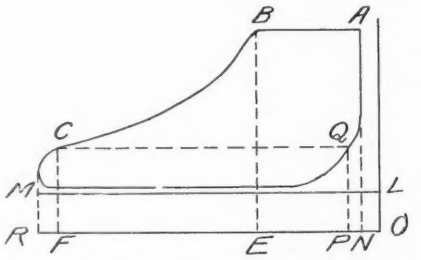


FIG. 3.—INDICATOR DIAGRAM, ILLUSTRATING METHOD OF COMPUTING STEAM CONSUMPTION.

of the expansion line as in the former case. The best point on the expansion line for making the measurements is just before release, as the greatest amount of leakage, as well as the reevaporation of a certain proportion of the steam which was condensed during the first part of the stroke, have had an opportunity to take place.

The foregoing methods of computation are best illustrated by working a practical example.

Let Fig. 3 represent a diagram taken from a twenty-four by forty-two-inch engine running at a speed of 100 revolutions a minute. The card was taken with a fifty-pound spring. Suppose we find by measurement the mean ordinate to be 0.85 inch, and the mean effective pressure = 0.85 × 50 = 42.5 pounds. Then the indicated horse-power =

$$\frac{42.5 \times 3.5 \times 452 \times 200}{33{,}000} = 407$$

In Fig. 3, L M is the atmospheric line, and O R the line of zero pressure drawn so that O L = 14.7 pounds. O N is the clearance volume, equal to six per cent of the piston displacement. The line P Q is drawn from O R to some point on the compression line. From C, a point on the expansion line just before release, the line C F is drawn perpendicular to O R. Then, measuring from the diagram, we have

O F = 3.5 inches;
O P = 0.38 inch;
C F = 0.80 inch;
P Q = 0.80 inch.

The length of stroke is forty-two inches, or 3.5 feet. Say we find from measurements that the length of the diagram is 3.5 inches. Then, one inch of the length of the card corresponds to one foot of the stroke. The scale of the spring used is 0.50. Therefore, we can easily reduce the above dimensions to pounds pressure, and to feet, which gives the following results:

O F = 3.5 feet;
O P = 0.38 foot;
C F = 40 pounds;
P Q = 40.8 pounds.

The area of the piston is 452 square inches, or 3.14 square feet.

We can now find the volume of steam at any point of the stroke. When the piston is at C, the volume is 3.14 × 3.5 = 10.9 cubic feet. When the piston is at Q, the volume is 3.14 × 0.38 = 1.19 cubic feet. From a steam table we find the weight of one cubic foot of steam at forty pounds absolute is 0.096 pound. Then, the weight of steam present when the piston is at C is 10.9 × 0.096 = 1.046 pounds. The weight of steam present when the piston is at Q is 1.19 × 0.096 = 0.114 pound.

The weight of steam in the cylinder at release is 1.046 pounds, and the weight kept for compression 0.114 pound. The weight exhausted per stroke is therefore 1.046 — 0.114 = 0.932 pound. This quantity multiplied by the number of strokes per hour will give the weight of steam to be accounted for by the diagram, and this subtracted from the actual weight of feed-water used during this time will give the cylinder wastes due to condensation and leakage.

In regard to the actual use of the indicator itself, much has been written, and full directions are also provided by the makers with the instrument.

The number of the spring to be used in any particular case depends mainly on the boiler pressure; as a general rule, however, the lightest spring that can safely be employed is preferable, because the lighter the spring the higher will be the

diagram, and hence the more accurate the measurements made. For the purpose of comparison it will be found advantageous to employ the same spring, where admissable, in taking diagrams from various engines under various conditions, as such comparison can then be made without making allowance for change in the tension of the spring.

TABLE OF SPRINGS AND MAXIMUM PRESSURES FOR THE SAME.

Scale of Spring.	Maximum Safe Pressure.
8	10
10	15
12	20
16	24
20	40
24	48
30	70
30	75
40	100
48	120
50	125
60	150
64	160
80	200
100	250

A No. 40 spring is a good standard for pressures below 80 or 90 pounds. For low pressures in compound engines it is customary to employ springs below No. 20.

For engines of high relative speed it is well to employ springs of high tension to insure a smooth line in the diagram.

To obtain clear, sharp lines on the diagram, the pencil lead should be frequently sharpened. In employing chemical paper, with which very satisfactory results are obtained, a metallic marking point, instead of a pencil point, is used. A piece of ordinary brass wire, suitably sharpened, will answer for the marking point. The lines made in this manner are very clear and distinct, but will disappear in a short time. It is therefore necessary, in order to preserve the diagram, to trace over the lines with a pencil or pen within a few days after they are made.

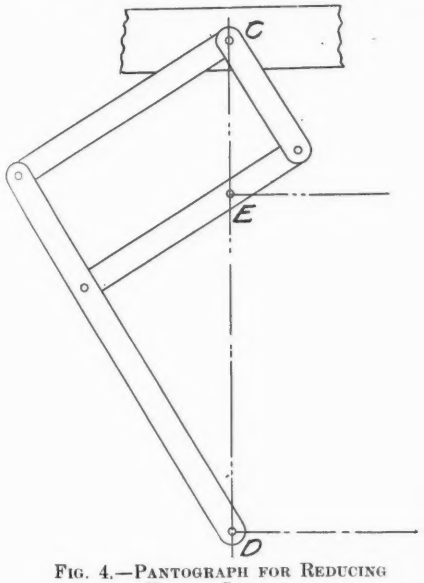


FIG. 4.—PANTOGRAPH FOR REDUCING ENGINE STROKE.

To attach the indicator, a hole should be drilled and tapped at each end of the cylinder, a short distance from the cylinder heads (unless, as is generally the case nowadays, this was done when the engine was being built), to fit a one-half-inch steam pipe. The indicator is attached to this pipe. Care should be taken to drill the holes so that they can not be interfered with by the piston, and wherever the pipes are attached they should communicate freely with the steam in the cylinder throughout the entire length of the stroke.

In drilling and tapping holes in a cylinder, care should be exercised that chips do not enter it. A simple method for preventing chips getting into the cylinder is to admit steam into it while the work of drilling and tapping the holes is being done, so that the chips will be blown out as fast as they accumulate.

The piping, bends, cocks and valves should in all cases be so constructed as to form a free and unobstructed passage for the flow of the steam from the engine cylinder to the indicator cylinder.

The most satisfactory results are obtained by the employment of two indicators, one at each end of the cylinder, for the reason that long pipes and an excessive number of bends are thus avoided. These are especially detrimental in indicating high-speed engines. In all such cases the indicator should be placed as near to the cylinder as possible, so as to reduce the length of steam pipe to a minimum. If, however, but one indicator is available and it is not necessary to take cards at too short intervals, it should be used first at one end and then at the other end of the cylinder.

Should there be a necessity for placing the indicator at the centre of the cylinder, large pipes and easy bends will, to a great extent, avoid the errors due to long piping. In such cases a three-way cock should be employed, in which the steam follows easy bends instead of sharp angles. It is provided with an expansion joint for convenience in making connections and to allow for any alteration in the length of the pipe due to expansion or contraction.

Before attaching the indicator the cock should be opened and the pipes blown out and thoroughly cleared of all loose material that may have collected in them.

Everything being properly connected and adjusted, stretch a blank card smoothly around the drum of the indicator and fasten the ends with the spring clips. Attach the driving cord so that the motion of the drum will be central; that is, so that it will revolve just as far in one direction on the forward stroke of the piston as it revolves in the opposite direction on the return stroke. Open the cock to admit steam to the indicator till all the parts have become warmed. Shut the steam off, bring the pencil or marking point in contact with the paper, adjust

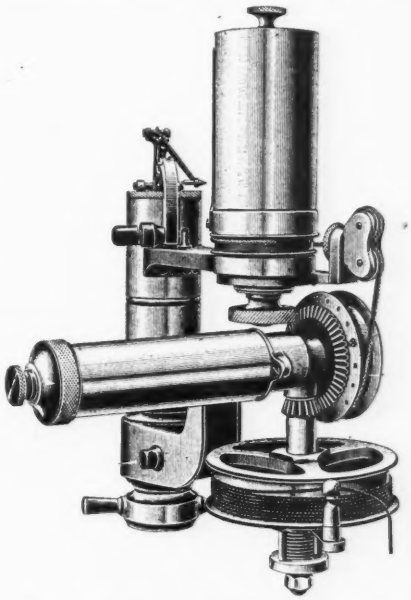


FIG. 5.—GEARED REDUCING MOVEMENT.

the top screw, and trace a fine line upon the card. This is the atmospheric line. Open the cock, and after two or three revolutions apply the pencil to the card and take the diagram. If it is desired to ascertain the condition of the valve adjustment, the pencil need only be applied while the engine is making one revolution. But to determine the power, the pencil should be applied a number of times, so as to obtain a number of diagrams superimposed on the same card. The fluctuation in the admission of steam, produced by governors which do not regulate closely, are so common that this course should always be pursued to obtain average results. After the diagram has been traced and the cock has been closed, the pencil should be applied lightly to the paper to see whether or not the position of the atmospheric line has been changed. If a new line is traced it is evidence of an error or derangement, and the operation should be repeated on a new card.

Numerous devices are used to reduce the stroke of the engine to that of the indicator drum. The lazy tongs and other forms of the pantograph are quite common; a type of the latter is shown in Fig. 4. It is constructed of light strips

of hard wood of sufficient thickness to withstand bending from its own weight. The point C is pivoted to a post or other rigid piece of timber, and the point D is pivoted to the cross-head of the engine and will travel a distance equal to the stroke of the engine. At the point E is attached the cord which communicates with the indicator drum, and its travel is equal to the reduced stroke on the indicator card. All the other joints are pin-hinge joints, made to work as freely as possible without destroying the rigidity of the apparatus.

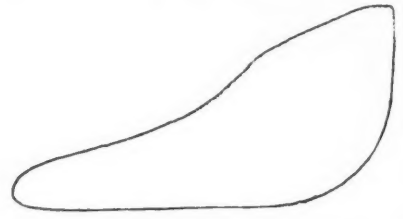


FIG. 6.—TYPICAL HIGH-SPEED ENGINE CARD.

The objection to all home-made reducing motions is that they are more or less inaccurately constructed, and very quickly give evidence of variations on the indicator card. The size, too, of most of these instruments is a detriment to their use; for, in a reducing motion such as is shown in Fig. 4, the length of the stroke of the engine is to the length of the reduced stroke as the distance C D is to C E. It therefore follows that if the engine stroke is, for example, thirty inches, the reduced stroke three inches, and we construct our pantograph reducing motion so that the distance C E equals ten inches, our proportion stands 30 : 3 : : C D : 10, or C D would equal $\frac{30 \times 10}{3} =$ 100 inches, which would be an inconvenient size to manage and quite impracticable.

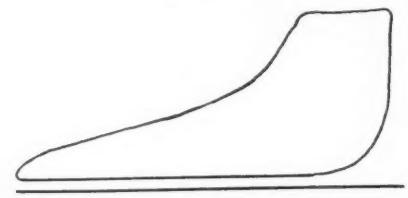


FIG. 7.—TYPICAL CARD FROM CORLISS ENGINE.

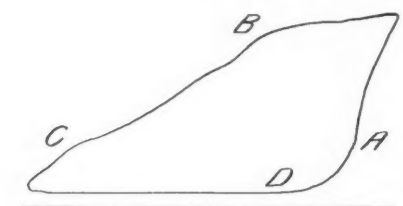


FIG. 8.—CARD SHOWING TOO-EARLY ADMISSION.

An improved reducing motion device is shown in Fig. 5. It occupies much less space than the pantograph and is, on the whole, a more satisfactory method of attaining the desired result.

Sometimes an engine appears to run well, but a careful study of the indicator diagrams may show that considerable saving might be made by correcting defects in the valve setting.

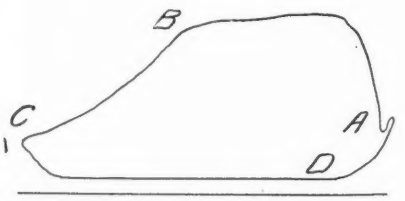


FIG. 9.—CARD SHOWING LATE ADMISSION.

The type of engine has much to do with the appearance of the diagram, and this must be taken into account when comparing cards from different engines. This fact is emphasized in Figs. 6 and 7, which show diagrams from a typical high-speed slide-valve engine of small size, and a Corliss engine running at low speed.

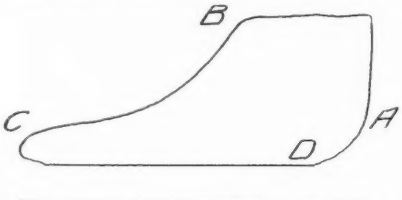


FIG. 10.—CARD SHOWING EXCESSIVE BACK PRESSURE.

The most effective steam distribution in the cylinder depends upon the proper timing of the different events, such as admission, cut-off, release and compression, and an inspection of the indicator card will tell at once which of these require adjustment to obtain the best results.

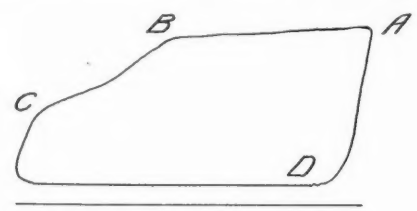


FIG. 11.—CARD ILLUSTRATING LATE CUT-OFF.

The following figures have been chosen to illustrate defective valve setting in various ways and will be found useful in connection with a discussion of this subject in a following article.

In all of the diagrams shown, let A represent the point of admission, B the cut-off, C release and D compression.

The card in Fig. 8 shows too-early admission, the admission line curving backward instead of rising perpendicular to the atmosphere as it should with a well-adjusted valve. With a plain slide valve, if one of the events takes place too early, all of the others are likely to have the same fault, which is the case with the card under discussion. This shows too much angular advance, and the eccentric should be shifted backward slightly upon the shaft.

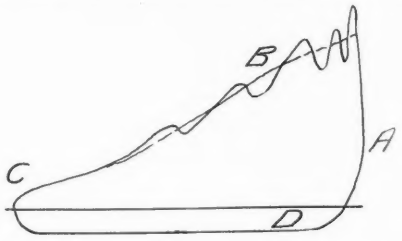


FIG. 12.—CARD FROM CONDENSING ENGINE.

The opposite defects are shown in Fig. 9, where all of the events occur too late in the stroke. Here the admission line curves forward and release takes place at the end of the stroke. The eccentric in this case should be shifted backward. In Fig. 10 the steam distribution is good, but the card shows too much back pressure, which may be due to small ports or the use of exhaust steam for heating or drying purposes. In Fig. 11 cut-off takes place so late in the stroke that steam is wasted through being exhausted at a comparatively high pressure.

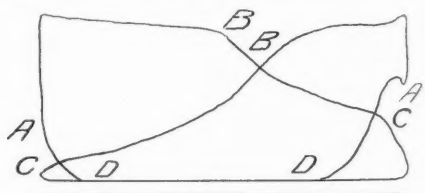


FIG. 13.—CARD SHOWING UNBALANCED LOADS ON ENGINE.

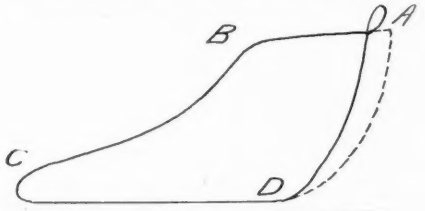


FIG. 14.—CARD ILLUSTRATING EXCESSIVE COMPRESSION.

Fig. 12 shows a card taken from a condensing engine, in which case the back-pressure line is of course below the atmospheric line. The wavy steam line is caused by the vibration of the indicator

parts when attached to a high-speed engine. Before measuring the area of a card of this kind, an "average line" should be drawn as indicated by the dotted line in the cut, and this taken as the true outline of the diagram. The pair of diagrams shown in Fig. 13 are from a slide-valve engine. Although the admission lines are good, the sloping steam lines to the point of cut-off indicate wire drawing due to small steam ports or a slow movement of the valve. The areas of the two cards are unequal, the late cut-off and resulting late compression of one end increasing the area of that card more than the too-early cut-off and too-early compression of the other.

The cards should be equalized by adjusting the angular advance and length of valve stem.

Fig. 14 shows a compression line extending above boiler pressure. In computing the horse-power, the area of the small loop should be subtracted from the area of the card. If it is desired to keep the cut-off the same the compression can be reduced by increasing the inside lap.

The proper amount of compression depends upon the type and speed of engine, varying from 0.9 of initial pressure in high-speed engines to 0.2 to 0.4 in those of low speed. It is not always possible in the case of a slide valve to arrange all of the events to the best advantage, but in general we may say: for too much compression, decrease the inside lap; for too early cut-off, decrease the outside lap. If the valve travel is increased, compression is decreased, and release is also retarded.

American Street and Interurban Railway Engineering Association.

The executive committee of the American Street and Interurban Railway Engineering Association desires to have presented at the next convention a report upon car houses, to consist of a compilation of plans and synopsis of specifications of some of the more recent types. To make the report as comprehensive as possible, it is desired to include car houses of the smaller roads, as well as those of the larger ones. The committee requests that the general managers and engineers of street and interurban railway companies send plans, photographs and descriptions of car houses possessing features of interest to Fred N. Bushnell, Stone & Webster Engineering Corporation, Boston, Mass.; N. W. Graburn, Montreal Street Railway Company, Montreal, Quebec; or R. C. Taylor, Indiana Union Traction Company, Anderson, Ind.

LIGHTNING PHENOMENA IN THE CLOUDS.[1]

BY CHARLES P. STEINMETZ.

Naturally, as soon as determinations of spark voltages became available, attempts were made to estimate the voltage of a lightning flash. Considering the discharge as that in an ununiform field, and requiring about 10,000 volts per inch, a lightning flash of two miles, or about 10,000 feet length, would require a potential difference of about 1,200,000,000 volts. The existence of such voltages in the clouds does not appear possible: a potential difference of 1,000,000,000 volts would produce a brush discharge of about one-half mile in length before the final lightning flash occurs. In the brush discharge the air is electrically broken down and conducting. But it is also mechanically and chemically broken down, that is, the molecules dissociated and recombined after the discharge in all possible combinations. That is, we get ozone and nitric acid, and a lightning flash produced by 1,000,000,000 volts might be so followed by a deluge of nitric acid. This, fortunately, is not the case.

An estimate of the voltage and the current in a lightning flash would not alone give the energy, if the duration of the discharge is not also known. We can, however, get an approximate estimate of the magnitude of the energy of the lightning flash indirectly from photometric considerations, and eliminate the consideration of the duration of the flash by the integrating feature of the human eye for impressions of very short duration. An impression on the human eye persists for about 0.1 second, and any phenomenon of shorter duration than this appears to last this time. Hence the effect on the eye by a lightning flash would be about the same whether the flash lasts 0.1 second or is of an intensity 1,000 times greater, but lasting one-thousandth of the time. This means that the eye would see a lightning flash about in the same manner as if its light, and probably its energy, were spread uniformly over one-tenth of a second.

The illumination given by a brilliant lightning flash is about of the same magnitude as good artificial illumination, perhaps one foot-candle, since at night-time, in a well-lighted room, the light of a lightning flash is quite appreciable. Estimating roughly one watt per candle foot, a lightning flash illuminating a space of two miles square, or 10^8 square feet, with one foot-candle would consume 10^8 watts, and as this is the illumination as averaged by the human eye over 0.1 second, the energy is 10^7 watt-seconds, or 10,000 kilowatt-seconds. The energy of a large lightning flash, estimated from its light, thus appears to be of the magnitude of 10,000 kilowatt-seconds. This value, while considerable when expressed in electric quantities, is by no means so very great: reduced to heat measure, it only equals the latent heat of evaporation or condensation of about nine pounds of water.

As seen, an estimate of the voltage of the lightning flash from length and disruptive potential gradient of the air, does not give reasonable values; that is, the lightning flash can not be a single discharge as that of a Leyden jar. An estimate of the voltage may be attempted in a different manner.

Lightning flashes usually occur within thunder clouds and only rarely from cloud to cloud or from cloud to ground. They therefore seem to be rather due to equalization of potential differences within the cloud than discharges between oppositely charged bodies. Lightning occurs mainly when rapid condensation of moisture takes place in the air, and the electric phenomena seem to be the more intense the greater the rapidity of condensation, or rain formation. Thus the atmospheric electric disturbances seem to be connected with the condensation of water vapor to clouds and rain.

Assuming water vapor in a higher stratum of the atmosphere to condense to moisture particles. These moisture particles have the potential of the air in which they float, that is, have a considerable potential difference, perhaps 100,000 volts or more, against ground, and so have an electric charge. These moisture particles conglomerate with each other to larger moisture particles and ultimately rain drops. By the collection of n^3 particles into one, the diameter of the particle has increased n fold. Its capacity has also increased n fold (the capacity of a sphere being proportional to the diameter). The particle contains, however, the accumulated charges of n^3 smaller particles, and n^3 times the charge, with n times the capacity, gives n^2 times the potential. It follows herefrom that with the conglomeration of the water particles, their potential must increase rapidly, proportional to the square of their diameter. The conglomeration of moisture particles in the clouds is, however, very uneven, due to the uneven distribution of moist-

[1] From an address on "Lightning and Lightning Protection," delivered before the thirtieth convention of the National Electric Light Association, Washington, June 15, 1907.

ure, as is plainly seen by looking at any cloud. As a result thereof, starting with a uniform potential in the stratum of the air where condensation begins, differences of potential distribution by necessity result from the differences in the condensation of water vapor to moisture and the accumulation of the moisture particles to larger ones; that is, the denser portions of the cloud are at a higher potential than the lighter portions.

Such potential differences in the clouds increase with increasing agglomeration of moisture particles to rain drops, and the potential gradient so rises. Assuming even as low a potential gradient as 100 volts per foot, in the cloud at the beginning of agglomeration of moisture particles. The collection of n^3 such particles to one rain drop of n times the diameter and so n times the capacity, but containing the static charge of n^3 particles, gives n^2 times the potential, and since the distances between the particles are now n times as large, the potential gradient has increased n fold. That is, by conglomeration of water particles, the potential gradient rises proportional to the diameter of the particles. Estimating then the average size of moisture particles as 10^{-4} inches at the beginning of agglomeration, when the potential gradient in the cloud is about 100 volts per foot, then the breakdown potential of the air, of between 100,000 and 200,000 volts per foot, would be reached when the drops have reached about 0.1 to 0.2 inch diameter, that is, the size of rain drops.

Potential gradients in the cloud gradually rise until the disruptive strength of the air is reached, and a discharge passes, equalizing the voltage at this spot. This, however, causes a greater potential gradient at the end of the discharge, exceeding the breakdown strength of the air, and so causes a second discharge, following over the path of the first, then a third and so on, until all of the potential differences or unequalities of the potential distribution in the cloud are leveled down by a series of successive discharges. The phenomenon is similar to that of a landslide, setting off another and another landslide. Or it can best be pictured by representing the unequal moisture distribution in the cloud by a relief map built of wet sand, the dense portion of the cloud, and so portions of high potential, being represented by the hills, the light or low-potential portions of the cloud by the valleys of the relief map. As soon as the sand dries, somewhere where the declivity is very steep, that is, the potential gradient very high, a slide occurs, this causes another slide, and so on, until the whole configuration of sand settles down to a flat and smooth shape, the hills are leveled off and the valleys filled.

The existence of such successive discharges, following each other after appreciable intervals of time in the same path, has been shown by the photographs of lightning flashes taken with a rotating camera. In this case, by the motion of the camera, the successive flashes are recorded side by side, and sometimes more than forty successive discharges have been counted, the whole phenomenon lasting about 0.6 second.

It follows herefrom that lightning flashes in the clouds, of several miles length, may occur without any considerable potential difference between the ends of the flash, but result from the disruptive equalization of the unequal potential distribution in the clouds, caused by unequal vapor density and unequal condensation and conglomeration of moisture particles.

This also explains the relatively small tendency for discharges between cloud and ground, across a space in which no condensation takes place, and where no unequal potential distribution supplies the power for the discharge. Although the distance between cloud and ground may be smaller than the distance traversed by a lightning flash in the clouds, and the average potential difference between cloud and ground probably greater than the potential differences in the clouds, a discharge to ground probably occurs in general only when, by a heavy downpour of rain, a range of high potential is carried bodily part way down to ground. This also may explain why lightning discharges to the ground are usually followed by a heavy downpour of rain.

Estimating, then, the disruptive strength of air under discharge conditions in a non-uniform field, and at the reduced air pressure in the clouds, as 100,000 volts per foot, the average potential gradient in the path of the lightning discharge through the clouds would be about 50,000 volts per foot. This gradient, however, would not be unidirectional, but the potential would rise from a low, or even negative, value at a light portion of the cloud to a maximum value at a dense position, and then decrease again; that is, give a gradient in the opposite direction, to a light position, etc., and the potential gradient would vary from nothing at a maximum potential point, to a maximum, equal to the breakdown strength of air at the starting point of the discharge, to zero at a minimum potential point.

To estimate the current, which discharges in the lightning flash, the conductivity of air in the path of the discharge, and the diameter of the discharge are required, and both are unknown, so that any estimate must be approximate only. The specific resistance of gases and vapors decreases with increasing temperature and with decreasing pressure. It is a few ohm-centimetres at atmospheric pressure, and the high temperature of the magnetite or carbon arc, and is also a few ohm-centimetres at the low temperature and low pressure of a high-current Geissler tube discharge. The mercury arc stream also gives a specific resistance of a few ohms. The temperature of the air in the lightning discharge probably is moderately high, but the pressure also not far from normal atmospheric, so that 100 ohm-centimetres may not be far from the true magnitude of the resistance. Estimating one to two feet as the diameter of the discharge path, and 100 ohm-centimetres as the specific resistance, and allowing for the inductance, gives, with an average potential gradient of 50,000 volts per foot, a current of about 10,000 amperes.

The heating effect and the magnetic effect of lightning strokes also point to the passage of currents of some thousands of amperes.

Assuming, then, the average potential gradient in the lightning flash as 50,000 volts per foot, the current as 10,000 amperes, a lightning flash of two miles length would represent a power of 5×10^9 kilowatts. Estimating the energy of the discharge as approximated from the photometric consideration, as 10,000 kilowatt-seconds, the duration of the discharge would be: $10^4/5 \times 10^9 = 2 \times 10^{-6}$ seconds, or two-millionths of a second.

The discharge probably is oscillatory. In view of the high resistance of the discharge path, the damping effect must be very great, and a very large part of the energy is expended in the first half wave. That is, the discharge consists of only one or a very few half waves. Hence a duration of the discharge of 2×10^{-6} seconds, assuming two half waves as the average, gives 500,000 cycles as the frequency.

Since the velocity of propagation of electric disturbances is the velocity of light, or 188,000 miles per second, the wave-length of a discharge of 500,000 cycles is about 2,000 feet.

A wave-length of 2,000 feet means that the current in the discharge flows in one

direction for 1,000 feet, then in the opposite direction, that is, with opposite potential gradient, in the next 1,000 feet, etc. Hence, the average distance through which the potential gradient has the same direction, or the distance between maximum and minimum, between densest of lightest parts of the clouds is about 1,000 feet. This agrees fairly well with the appearanace of the clouds to the eye, and it also agrees in magnitude with the distance over which the wind velocity varies, in gusts, as shown by Professor Langley in his investigations on the internal energy of the wind.

With an average length of the half wave of 1,000 feet, and 50,000 volts per foot as the potential gradient, the potential differences in the clouds would be of the magnitude of 50,000,000 volts. These are values which appear reasonable.

Assuming that an electric flash drains the electric energy of the cloud within a radius of about 100 to 200 feet from the path of the discharge, this affords a different method of estimating the magnitude of the energy of the lightning flash. Assuming, for instance, saturated air at forty degrees centigrade mixing with air at zero degrees centigrade, condensation of a part of the moisture occurs which can easily be calculated, and also the electrostatic capacity. With a wave-length of 2,000 feet, and a potential gradient of 50,000 volts per foot, from the capacity follows the energy of the electrostatic charge, which discharges as a lightning flash. This is found under the above assumption, as the magnitude of 10,000 kilowatt-seconds, which agrees with the results derived from the photometric considerations.

To conclude, then, the approximate values of magnitude of the electric quantities in a lightning flash may be estimated as follows:

Average potential gradient: 50,000 volts per foot at the moment of discharge.

Average potential difference between different points of the cloud: 50,000,000 volts.

Average current in the discharge: 10,000 amperes.

Average duration of the discharge: $\frac{1}{500,000}$ second.

Average frequency of discharge: 500,000 cycles.

Average energy of the discharge: 10,000 kilowatt-seconds, or 7,000,000 foot-pounds.

The Faraday Society.

The thirtieth ordinary meeting of the Faraday Society, of Great Britain, was held on Tuesday, June 25, 1907, when a general discussion on "Hydrates in Solution" took place.

The discussion was opened by Dr. T. Martin Lowry, who read a paper on "The Thermo-Chemistry of Electrolytes in Relation to the Hydrate Theory of Ionization," by W. R. Bousfield and himself. The process of ionization of a neutral salt in aqueous solution is usually attended with a development of heat. It is pointed out that the decomposition of potassium chloride into molecular potassium and molecular chlorine involves an absorption of 105,600 calories, and that a further absorption must accompany the decomposition of the molecules into atoms. The electrification of the atoms is also probably an endothermic action, and the change represented by the above equation, so far from involving the liberation of 250 calories, must actually involve the absorption of more than 100,000 calories.

The process of ionization must therefore involve some powerful exothermic action not shown in the ordinary scheme, and it is suggested that this is supplied by the combination of the charged atoms or "ionic nuclei" with the solvent to form hydrated ions.

A scheme was given whereby the work done in charging the ions, or in separating ions already changed, may be calculated on the assumption that the ions behave as charged conductors immersed in a fluid dielectric. The values deduced for the energy of electrification or of separation range from about 1,000 to 8,000 calories per equivalent.

It is pointed out that according to the theory of electrolytic dissociation the heat of formation of a salt in dilute solution is the sum of the heats of formation of the ions. Values are deduced for the separate ionic heats of formation, and a table is given showing with what remarkable accuracy the additive law holds good; this additive relationship, which does not appear in the heats of formation of the solid salts, affords important evidence in favor of the view that the ions exist independently in dilute solutions.

The majority of the heats of formation of the ions are large positive quantities. The energy liberated during the process of ionizing an element can not be due to the disruption of the molecules of the element into atoms, nor to the electrification of these atoms. Both of the above processes appear to be endothermic, and it is again necessary, in order to explain the thermochemical data, to postulate that ionization is accompanied by some exothermic action.

Dr. James C. Philip, M.A., read a paper entitled "Influence of Non-Electrolytes and Electrolytes on the Solubility of Gases in Water. The Question of Hydrates in Solution." The author supported the view according to which the diminished power of a solution to dissolve hydrogen and oxygen as compared with pure water is due mainly to the hydration of the solute and the consequent diminution of the "free" solvent.

Dr. George Senter read a paper on "Hydrates in Solution; Discussion of Methods Suggested for Determining Degree of Hydration." In forming an opinion as to the relative trustworthiness of different methods which have been suggested for determining the degree of hydration, regard must be had to the following considerations: (1) other things being equal, statical methods are more reliable than dynamical ones; (2) the law of mass action requires that for salts the degree of hydration must increase with dilution up to a point beyond which it remains practically constant on further dilution; (3) if, as is usually the case, hydration is associated with evolution of heat, the complexity of the hydrates must decrease with rise of temperature.

A paper communicated by Dr. Alex. Findlay on "The Stability of Hydrates as Indicated by Equilibrium Curves" was read also at this meeting.

Interborough-Metropolitan-Brooklyn Rapid Transit Investigation.

The Public Service Commission has authorized William M. Ivins to begin an investigation of the books of the Interborough-Metropolitan Company and the Brooklyn Rapid Transit Company, in connection with the general investigation of these two companies to be undertaken by the commission.

The resolution adopted by the commission reads as follows:

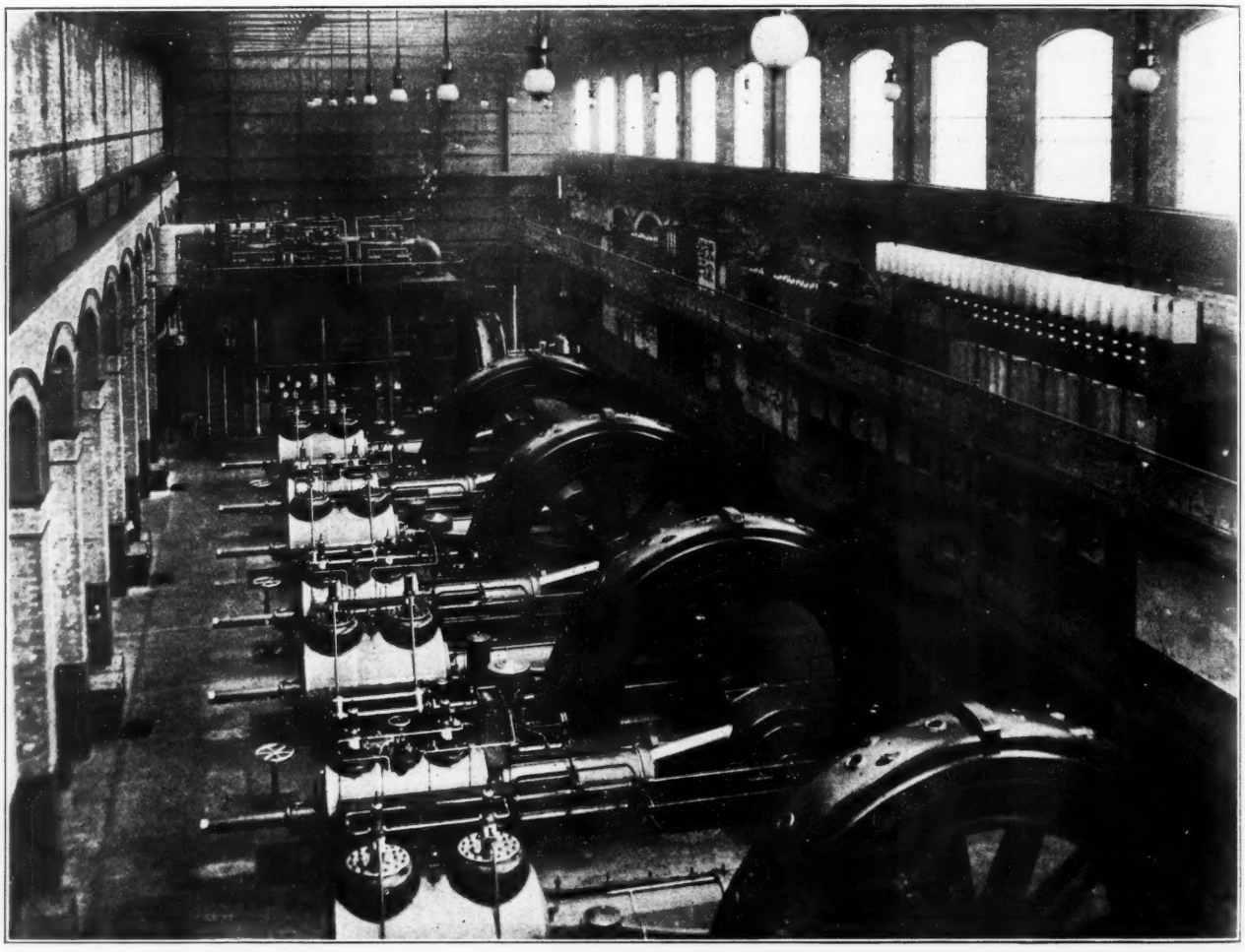
"*Resolved*, That William M. Ivins, special counsel to the commission, is hereby designated to inspect and examine any and all accounts, records, and memoranda, kept by all the street railroad corporations owned or controlled by or operated for, or on the account of the Interborough-Metropolitan Company or the Brooklyn Rapid Transit Company, and that such inspection and examination is hereby ordered."

London's Electric Light and Power.

By Albert H. Bridge.

FOR the present, at least, no big electric power scheme is to be proceeded with, the latest proposal of the London County Council, which in accordance with the views expressed by ratepayers at the March elections included the leasing of the powers to a company, having, for some unexplained reason, been rejected by the government. Although the existing companies were expecting to benefit from the carrying out of such a scheme by being able to buy very cheaply any additional supply required beyond their present plant capacity, they are not at all displeased with the prospect of another year or more of grace in which to act alone. It seems, however, from what one can gather, that the necessities of London call for a big, comprehensive scheme of some kind, and that the companies must have the possibility hanging over their heads continuously until something in the nature of definite advance is made. The companies contend that their linking up scheme for mutual interconnection of their different supply systems and centres would put them in a position to deal with the needs of the area effectually, without the intervention of any private parties, but there is practically no prospect of this bill of theirs getting through this year. So next year we shall probably start *de novo*. It is a practical certainty that there will not be a new scheme promoted by the present London County Council then. The private parties who have promoted the administrative project year after year and dropped many thousands of pounds without any benefit, have had enough of that sort of thing and they are hardly likely to enter the ring again. The existing companies will doubtless bring forward once more their present proposals, though probably on somewhat developed lines, and there may be a combination of municipal authorities on their own account.

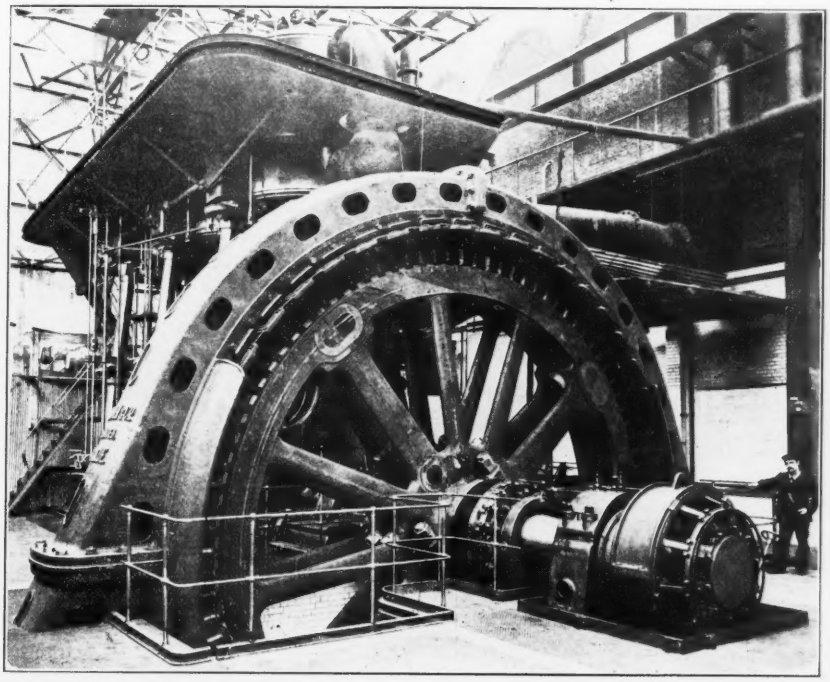
But for the present things remain as they were, and the companies which have spare plant capacity at their stations may proceed to develop their businesses to the utmost of their ability. The two principal companies that have a pretty considerable plant and mains capacity above and beyond the needs of the moment are the Charing Cross, West End and City Electricity Supply Company, Limited, and the Metropolitan Electric Supply Company, Limited. The former, several years ago when there was an electric railway demand anticipated, but which it could not meet because of the parliamentary limitation of its supply powers,



THE BOW GENERATING STATION OF THE CHARING CROSS, WEST END AND CITY ELECTRICITY SUPPLY COMPANY, LONDON, ENGLAND, SHOWING SULZER-LAHMEYER STEAM ENGINE GENERATOR SETS.

put down a large additional generating station at Bow, some miles outside its authorized area of supply. The fact that the new demand did not come on after a great amount of capital had been laid out on plant and mains, somewhat seriously affected the fortunes of the company, and it is still in a marked degree affected thereby. For instance, last year, although the aggregate plant capacity at the company's different stations, including Bow, was 20,400 kilowatts, the maximum load recorded was only 11,411 kilowatts, this including an exceptionally large loss in distribution which is generally a feature of the company's accounts, owing to a variety of causes.

At the Bow generating station a 10,000-volt, fifty-cycle, three-phase current is



3,000-Kilowatt Sulzer-Kolben Generating Unit at the Willesden Station of the Metropolitan Electric Supply Company, London.

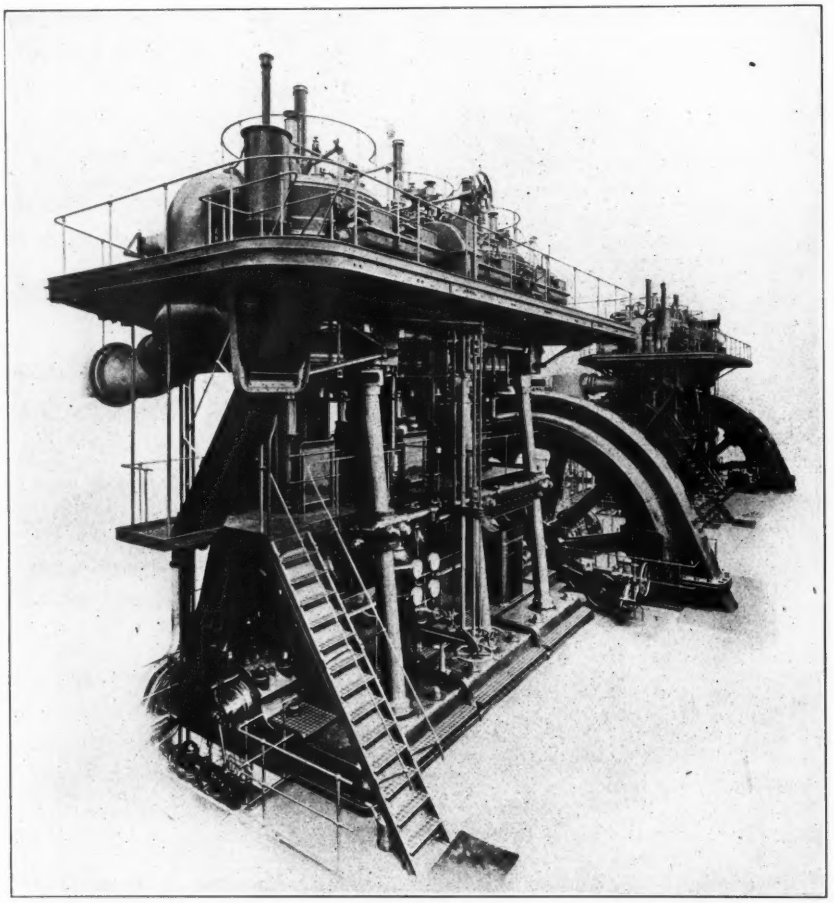
produced with transforming substations at certain points in the area of supply for turning out a direct current at the consumer's pressure. The boiler room has two rows of Hornsby boilers facing each other and coal bunkers of 7,500 tons capacity overhead. The engine room runs parallel to the boiler room. The length of the building is 300 feet, but the site will admit of its extension, if necessary, to 500 feet. In one of the accompanying photographs is shown the generating plant. It consists of two 800-kilowatt sets and four 1,600-kilowatt sets, and one 4,000-kilowatt set which was put to work last of all. The 800-kilowatt sets are driven by Belliss & Morcom three-cylinder, triple-expansion engines, running at 230 revolutions a minute and exhausting into jet condensers in the basement. The 1,600-kilowatt generators are driven by horizontal cross-compound type engines by Sulzer Brothers, of Winterthur, running at 83.3 revolutions a minute. The 4,000-kilowatt set consists of Sulzer engines of the vertical, three-cylinder compound type (speed 83.3 revolutions) and Lahmeyer rotating, field-type generators. All of the generators in the station are of this type. The magnet fields of the 800-kilowatt sets have twenty-six poles wound with copper wire and the 1,600 and 4,000-kilowatt sets have each seventy-two poles with windings of flat copper, edge wound. All the machines have two slots per pole per phase. It may be remembered that a full account of the equipment of the station and distributing system was given before the Institution of Electrical Engineers, of Great Britain, by W. H. Patchell shortly before his retirement from the chief engineership of the company last year. He is followed in that office by H. W. Kingston, who was formerly his chief assistant.

The Willesden station of the Metropolitan Electric Supply Company may also be singled out for similar reference in view of its surplus capacity and readiness to meet increased demand. As they stand, however, neither this company nor the Charing Cross, already referred to, can meet the consumer of power with the low rates that the promoters and engineers of the, for the time being, defeated projects hoped to be able to do, as a result of doing the thing on a much larger scale, with big turbo-generator sets and with cheaper sites, and so forth.

The Metropolitan has been in existence for about twenty years and in recent years has been most successful from a commercial point of view. It is one of those companies which commenced operations as an electric lighting concern and was just beginning to do well when the demand for cheaper supply for power purposes began to arise and when municipal authorities were buying up electric lighting undertakings that had been privately started in their districts. It was the good fortune of the Metropolitan to have a part of its system bought over at an enormous figure a year or two ago by the Marylebone Borough Council, and as that council has its fine turbo-generator station in full running the Metropolitan had a good surplus of plant, which was formerly employed supplying Marylebone, freed and available for any required purpose at Willesden. With a view to finding a use for this, extended powers for new district were obtained. The Willesden and other stations have an aggregate plant capacity of 18,500 kilowatts, but last year the maximum load recorded was 8,154 kilowatts. The Willesden plant consists of various makes of engines and generators. The main sets, which were part of the original equipment, consist of five 1,500-kilowatt, 500-volt, Westinghouse steam-driven alternators whose sixty-cycle current is transformed up to 10,500 volts for the transmission to the mid-London area and Paddington. The first three of these are fitted with Wheeler surface condensers and the other two have Cole, Marchant and Morley type condensers. The next plant added consisted of two 3,000-kilowatt sets, consisting of Sulzer vertical, compound, condensing engines driving two-phase, alternate-current generators of the Kolben type with revolving fields. There is also in the engine room a 3,000-kilowatt Dick-Kerr alternator driven by a Willans & Robinson steam turbine.

The switchboard for the Kolben generators is for the usual Ferranti cell-type pattern, and for the Westinghouse machines, of the Westinghouse usual design. All is erected on a platform running along the west side of the station. The current is then conducted by heavy concentric mains through a subway into the trans-

former house, where it is raised to the required pressure for transmission into London by means of a number of 250-kilowatt, Berry transformers, which convert the pressure from 500 to 10,500 volts. The boiler-house equipment includes Babcock & Wilcox water-tube boilers, Davey-Paxman, dry-back boilers and Fraser's dry-back boilers. Six large Donat cooling towers outside the boiler house deal with the circulating water. Coal is conveyed from the railway to the bunkers above the boiler house by a special Bennis tippler and chain conveyer, or from barges by a Temperley transporter.



3,000-Kilowatt Generating Units at the Willesden Station—Showing the Vertical Compound Sulzer Engines.

The London Electric Supply Corporation, at whose Deptford generating station in the very early days of electric lighting Ferranti carried out his pioneering high-tension work, is a company which has been enterprisingly handled during recent years in regard to power supply, but it is able to do a great deal more than is called for at its present rates. With a plant capacity of 12,800 kilowatts, it had a maximum load last year of 6,000 kilowatts. The City of London Company has a plant capacity of 24,000 kilowatts and its maximum recorded load last year was 17,000 kilowatts.

It has been complained that in meeting the demand of the public for lower charges per unit, as a result of the great publicity given to the probable effect of big power schemes, the companies have reduced their power rates to a point where they are practically unprofitable. They have had to do this at a time when gas competition has become much keener than formerly, with a resultant falling off in electric progress, if not an actual loss of consumers. Whether they will adopt a policy of charging profitable rates, or whether they will think their interests are best served by a policy of enterprisingly getting hold of every possible consumer while they have a free hand without the bulk supplier, it will be interesting to see.

THE COSTS OF ELECTRICITY SUPPLY AND THEIR RELATION TO SCALES OF CHARGES.[1]

BY H. R. BURNETT.

Broadly speaking there are three classes of supply for which practically all central stations have to cater and for which scales of charges have to be fixed.

(1) Lighting—Under this heading are included all ordinary lighting consumers whose supply may reasonably be expected to increase, to a lesser or greater extent, the maximum demand upon the generating plant.

(2) Power and heat, including all ordinary users of the supply for these purposes, whose supply, by reason of the hours at which it is required and the large diversity factor, does not materially increase the maximum demand upon the generating plant.

(3) Special, including supply for public lighting, traction, large power and other consumers, who, by reason of the extent or conditions of their supply, are entitled to special consideration.

The scale or scales of charges for each class of consumers should be so arranged that each consumer, as far as possible, bears a fair proportion of the standing charges as well as the running costs incurred on his behalf, and that over and above these charges his supply should result in a reasonable profit to the undertakers.

(1) Supply for Lighting—The scale or scales of charges for supply for lighting are necessarily based upon the maximum demand system, and a curve representing the cost of production for different outputs is of considerable assistance in deciding what the scale should be.

It must be borne in mind that there are always a certain number of short-hour consumers who do not bear their fair proportion of the standing charges, and who must, in consequence, be supplied at a loss, which loss has to be made up by increasing the profit on the long-hour consumers.

Having decided what is the maximum demand scale upon which the works can supply at a profit, the fixing of flat rates for various classes of consumers is a simple matter.

For example, suppose the maximum demand rate decided upon is:

Twelve cents per kilowatt-hour for the first hour's use of maximum demand per day.

[1] Abstracted from a paper read at the annual convention of the Incorporated Municipal Electrical Association of Great Britain, at Manchester, England, June 27.

Six cents per kilowatt-hour for the remainder.

In a provincial town, such as that with which the author is connected (Barrow-in-Furness), it is found that the average consumption in ordinary shops is equivalent to two hours' use of the maximum demand per day. In dwelling houses and public houses three hours per day. It follows, therefore, that the flat rates for these consumers should be:

Shops (two hours per day), flat rate, nine cents per kilowatt-hour.

Public houses and dwelling houses (three hours per day), eight cents per kilowatt-hour.

(2) Supply for Power and Heat—The fixing of a scale or scales of charges for power and heat supply upon an equitable basis is a very much more difficult matter than in the case of lighting supply, owing to the great variety of purposes for which the supply may be required.

Connected to the mains of almost any undertaking it will be found that there are consumers, using approximately the same number of units per annum, having the same maximum demand, possibly using the power for similar purposes and paying the same rate per unit—yet one may be using his supply at such times as to increase the maximum demand upon the generating plant by the amount of his demand, while another uses his supply at such hours as to result in no increase in the demand upon the generating plant. Obviously the one consumer is very much more desirable from the supplier's point of view than the other—yet no scale of charging in vogue, other than the two-rate referred to hereafter, will discriminate between the two.

Where the maximum demand system is adopted for power supply, the rough and ready method of fixing the scale of charges appears to be to make the initial and final prices per unit about one-half of those decided upon for the lighting supply.

It is generally found expedient to have an alternative flat rate or sliding scale, in which the price per unit is usually about the same as that to which the consumer would be entitled on the maximum demand system by two hours' daily use of the supply.

(3) Special—The third and perhaps most important class of consumers for whom the engineer has to decide upon scales of charges are those who, by reason of the nature or extent of their supply, are entitled to special consideration. Under this category the author includes public lighting, traction supply, supply to large power or lighting consumers, and stand-by supply.

In considering the price to be charged for any of these purposes, it is well to bear in mind that the charge should be made up of the following items, *viz.*:

(1) Running charges, consisting of a proportion of the works costs.

(2) Standing charges, consisting of:

(*a*) Proportion of works costs.

(*b*) Proportion of rents, rates and taxes.

(*c*) Proportion of management charges.

(*d*) Proportion of capital charges (general).

(*e*) Special capital charges.

(3) Profit.

(1) This item is ascertained from the curve of costs of production.

(2) (*a*), (*b*), (*c*), (*d*), (*e*). It is usual to apportion all these items according to the maximum demand of the consumer, and in cases where the consumer's maximum demand is liable to occur simultaneously with the maximum load upon the generating station, this is a rational course to follow.

(3) When the above charges have been properly apportioned, it is only necessary to add a small percentage, say ten per cent, for profit.

SUPPLY DURING RESTRICTED HOURS.

When the supply is only given at such hours that it will not increase the maximum load upon the generating station, the standing charges (2), (*a*), (*b*), (*c*), (*d*) will not be materially affected by the supply, and the price charged should therefore be made up of the following items:

(1) Running charges.

(2) (*e*) Capital charges on special capital expenditure, if any.

(3) Profit.

The running charges are ascertained as before from the curves showing the cost of generation, and the effect of any special capital expenditure (such as an extension of mains) entailed by the supply is easily calculated and must be allowed for.

The allowance for profit should, however, in this case be considerably increased to cover the use of plant, mains, etc. Exactly what margin should be allowed is, of course, a matter of opinion, but in justice to the consumers who have the capital charges upon the plant to bear, and as a matter of sound business, the allowance should, in the opinion of the author, be in the neighborhood of fifty per cent on the cost. Even with this margin for profit the prices arrived at are quite moderate. The important bearing which even a comparatively small special capital expenditure may have upon the price which should be charged is often overlooked.

SUGGESTED BASIS FOR FIXING SCALES OF CHARGES.

The author suggests a schedule of charges based upon the following lines:

Supply for lighting:

(1) A maximum demand rate so arranged that the price charged to a consumer using the supply for two hours per day, is from ten per cent to fifteen per cent in excess of the ascertained cost of the supply.

(2) (*a*) An optional flat rate for any consumer based upon two hours daily use of the supply on scale (1).

(2) (*b*) Optional flat rates for particular classes of consumers, such as hotels, clubs, public houses, and dwelling houses, based upon scale (1), the rate being fixed according to the ascertained average daily use of the supply by these consumers.

Supply for power and heat:

(3) A maximum demand rate in which the initial and final prices are each one-half of the prices charged on scale (1).

(4) An optional flat rate for all consumers based upon two hours daily use of the supply on scale (3).

Supply to special consumers:

(5) The price charged to be the ascertained cost of supply plus ten per cent to fifteen per cent for profit.

Restricted hour or two-rate supply:

(6) The price to be based upon the ascertained "running costs" of supply plus fifty per cent for proportion of standing costs, use of plant, and profit. Any supply taken between sunset and 12 midnight to be charged at maximum price on scale (1).

SLIDING SCALES.

In cases where it is deemed desirable to adopt a sliding scale, the scale should be obtained by varying the discount upon the flat rate according to the consumption as follows:

For first 1,000 kilowatt-hours (or other quantity) per quarter, price = flat rate, net.

For the next 1,000 kilowatt-hours per quarter, price = flat rate less ten per cent.

For the next 1,000 kilowatt-hours per quarter, price = flat rate, less fifteen per cent.

For all over 3,000 kilowatt-hours per quater, price = flat rate, less twenty per cent.

By arranging a sliding scale in this manner, the anomalous position of a consumer being able to reduce his total bill by increasing his consumption (which is possible upon the scale of charges in force in some towns) is avoided.

Report of the Committee on Investigation of Public Ownership.

The final report of the conclusions of the Committee on Investigation of the National Civic Federation Commission on Public Ownership and Operation has been made public. This committee, of which Melville E. Ingalls, chairman board of directors Big Four Railroad, is chairman, made a thorough investigation of municipal and private workings of gas, electric light, water and street railway plants, both in the United States and England. Of the committeemen, all but one, Walton Clark, of Philadelphia, who presents a separate paper giving his views, sign the report. Charles L. Edgar, of Boston, and W. J. Clark, of New York, present a statement of minor exceptions. The conclusions reached give in detail the opinions of the committee on all the various questions connected with the public ownership problem, and present a number of recommendations on the subject. The report in part is as follows:

"It is difficult to give positive answers of universal application to the questions arising as to the success or failure of municipal ownership as compared with private ownership. The local conditions affecting particular plants are in many cases so peculiar as to make a satisfactory comparison impossible, and it is very difficult to estimate the allowance that should be made for these local conditions.

"Further, the difficulty of reaching satisfactory results by the comparative method is not confined to special or local conditions. It is true, as well, of much broader questions. Thus any attempt to compare municipal with private electric light plants in the United States would be fruitless if allowance were not made for the fact that in most cases such municipal plants are confined to street lighting and may not do commercial business. Allowance must be made also for the fact that many municipal plants have had a struggle to exist in the face of unsympathetic public opinion. Again, in England consideration must be given to the fact that the municipal electric light and street railway plants have permanent rights, while the rights of the private companies operating these particular utilities are limited as to the length of their existence, many street railway franchises expiring twenty-one years after they were granted.

"Finally, not only must it be borne in mind that the social and political conditions which characterize the two countries find expression in their private and public systems, but we must consider the difference in the nature of the two peoples which causes them to adopt different ideas and views as to the expediency of certain things. In other words, a measure of success in the municipal management of public utilities in England should not be regarded as necessarily indicating that the municipal management of the same utilities in this country would be followed by a like measure of success. Conditions are quite different in the two countries.

"There are some general principles which we wish to present as practically the unanimous sentiment of our committee.

"First, we wish to emphasize the fact that the public utilities studied are so constituted that it is impossible for them to be regulated by competition. Therefore, they must be controlled and regulated by the government; or they must be left to do as they please; or they must be operated by the public. There is no other course. None of us is in favor of leaving them to their own will, and the question is whether it is better to regulate or to operate.

"There are no particular reasons why the financial results from private or public operation should be different if the conditions are the same. In each case it is a question of the proper man in charge of the business and of local conditions.

"We are of the opinion that a public utility which concerns the health of the citizens should not be left to individuals, where the temptation of profit might produce disastrous results, and therefore it is our judgment that undertakings in which the sanitary motive largely enters should be operated by the public.

"We have come to the conclusion that municipal ownership of public utilities should not be extended to revenue-producing industries which do not involve the public health, the public safety, public transportation, or the permanent occupation of public streets or grounds, and that municipal operation should not be undertaken solely for profit.

"We are also of the opinion that all future grants to private companies for the construction and operation of public utilities should be terminable after a certain fixed period, and that meanwhile cities should have the right to purchase the property for operation, lease or sale, paying its fair value.

"To carry out these recommendations effectively and to protect the rights of the people, we recommend that the various states should give to their municipalities the authority, upon popular vote, under reasonable regulations, to build and operate public utilities, or to build and lease the same, or to take over works already constructed. In no other way can the people be put upon a fair trading basis and obtain from the individual companies such rights as they ought to have. We believe that this provision will tend to make it to the enlightened self-interest of the public utility companies to furnish adequate service upon fair terms, and to this extent will tend to render it unnecessary for the public to take over the existing utilities or to acquire new ones.

"Furthermore, we recommend that provision be made for a competent public authority, with power to require for all public utilities a uniform system of records and accounts, giving all financial data and all information concerning the quality of service and the cost thereof; which data shall be published and distributed to the public like other official reports; and also that no stock or bonds for public utilities shall be issued without the approval of some competent public authority.

"We also recommend the consideration of the 'sliding scale,' which has proved successful in some cases in England with reference to gas and has been adopted in Boston.

"In case the management of public utilities is left with private companies, the public should retain in all cases an interest in the growth and profits of the future, either by a share of the profits or a reduction of the charges, the latter being preferable as it inures to the benefit of those who use the utilities, while a share of the profits benefits the taxpayers.

"Our investigations teach us that no municipal operation is likely to be highly successful that does not provide for:

"First—An executive manager with full responsibility, holding his position during good behavior.

"Second—Exclusion of political influence and personal favoritism from the management of the undertaking.

"Third—Separation of the finances of the undertaking from those of the rest of the city.

"Fourth—Exemption from the debt limit of the necessary bond issues for revenue-producing utilities, which shall be a first charge upon the property and revenues of such undertaking.

"We wish to bring to your consideration the danger here in the United States of turning over these public utilities to the present government of some of our cities. Some, we know, are well governed and the situation on the whole seems to be improving, but they are not up to the government of British cities. We found in Eng-

land and Scotland a high type of municipal government, which is the result of many years of struggle and improvement. Business men seem to take a pride in serving as city councillors or aldermen, and the government of such cities as Glasgow, Manchester, Birmingham and others includes many of the best citizens of the city. These conditions are distinctly favorable to municipal operation."

Charles L. Edgar and William J. Clark dissent from the conclusions of the committee's report on the following points:

First—That there are no particular reasons why the financial results from private or public operation should be different if the conditions are the same, as this implies that the conditions are or are likely to be the same.

Second—That a public utility which concerns the health of the citizens should not be left to individuals, where the temptation of profit might produce disastrous results, and therefore it is their judgment that undertakings in which the sanitary motive largely enters should be operated by the public, since this conclusion has not been proved by the investigation. In the opinion of Messrs. Edgar and Clark, privately operated water systems were as properly and successfully managed as the publicly operated water systems.

Third—That municipal ownership of public utilities should not be extended to revenue-producing industries which do not involve the public health, the public safety, public transportation, or the permanent occupation of public streets or grounds, and that municipal operation should not be solely for profit, because this sentence is so drawn that to a casual reader it implies that the opposite is advisable.

Fourth—The recommendation that to carry out these recommendations effectively and to protect the rights of the people the various states should give to their municipalities the authority, upon popular vote under reasonable regulations, to build and operate, or build and lease, or take over works already constructed; because the words "under reasonable regulations" were put into the report at the suggestion of Mr. Edgar, and were intended by him to mean such regulations as would compel deliberate consideration not only by the people, but by their representatives, and would consequently prevent the superficial attractiveness of the scheme from overriding the sober second thought of the people, and they strongly dissent from any definition of regulations which does not carry these points.

Walton Clark, third vice-president of the United Gas Improvement Company, in a separate paper, sets forth his agreement with the other members of the committee that "companies entrusted with franchises and charters for the operation of so-called public service industries should be subject to regulation." He dissents, however, from the statement of the committee regarding waterworks, and also from the statement, speaking of politics in Glasgow, Manchester and Birmingham, that these conditions are distinctly favorable to municipal operation, if by this is meant a municipal ownership that may be favorably compared with private ownership, in the character of its results and in benefit to the city and citizens served.

On the general subject of municipal ownership, Mr. Clark says the investigation in which he has taken part has convinced him that municipal ownership has not proved equal to private ownership, in benefits to the consumer, citizen or city. He does not agree that the way should be left open for any municipality to undertake any trading operation, without special authorization by the legislature of the state wherein it is located.

Mr. Clark also dissents from the opinion that a city should have the right to purchase at its option the property of public-service corporations for operation, lease or sale. He bases his opposition on the belief that it is practically impossible to secure private funds for investment in an enterprise subject to purchase by a municipality at any date to be selected by the municipality, and because he believes that the impossibility of so securing private investment may, and often will, work a social harm to a community.

Finally, Mr. Clark says he is convinced that the condition of the British people, individually or collectively, has not been improved by the municipalization of the industries investigated; and that political and social conditions in the United States are less favorable to the success of municipal ownership than are the same conditions in Great Britain. This conclusion is strengthened by the committee's investigation into municipalized industries in the United States. He is convinced that, under American conditions, the system of private ownership of public utilities is best for the citizens and the consumers. He recommends state regulation and protection of public-service companies, provided by statute, and as far as possible automatic in its application and operation.

Telephotography in Germany.

United States Consul Thomas H. Norton, of Chemnitz, reports that much attention is now paid in Germany to the success which has attended the installation of Professor Korn's invention for the transmission by wire of photographic reproductions over long distances. His latest experiments show that nearly as satisfactory results are secured by making use of ordinary telephone wires as on lines specially constructed for the purpose. The only difficulty encountered on telephone wires results from calls on adjoining wires. These cause the formation of zigzag lines on the reproduced picture at the receiving station, which are easily corrected by retouching. Alterations in current intensity by ringing on or ringing off, as well as during conversations over adjoining wires, are without effect. It is further shown that the wire employed for photographic reproduction can simultaneously be utilized for telephonic conversation. The first journal to utilize the new invention is the Copenhagen daily *Politiken*, which has ordered a complete installation for telephonic and telephotographic communication with its Berlin office.

Code of Rules for Motormen and Conductors.

At the Columbus convention of the American Street and Interurban Railway Association, held last October, the committee on Standard Code of Rules submitted a report in which were embraced a code of general rules for the government of motormen and conductors of city roads, another code applicable to interurban roads and a third for high-speed electric roads. These rules are printed in the twenty-fifth annual report of the association and have also been issued in pamphlet form.

This committee now desires to know if these rules have been generally adopted and for this purpose is sending out a data-sheet, which the railroad companies are requested to fill out and return. If the rules are not in use, the reason for this is asked; also, when the rules in force differ from the code, the differences are requested.

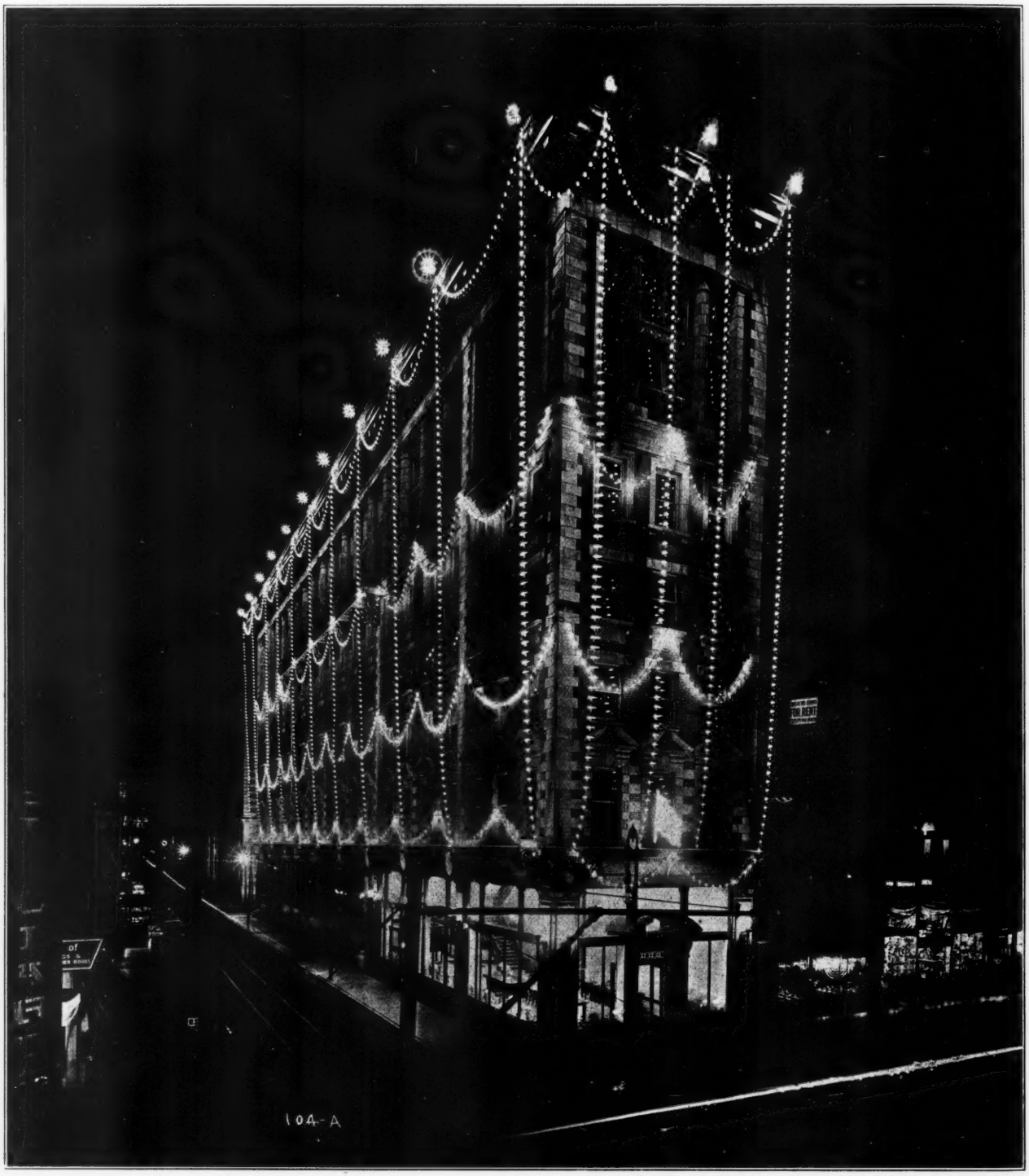
The committee asks for suggestions and copies of other rules now in force.

These data-sheets may be obtained from the secretary of the association, B. V. Swenson, 29 West Thirty-ninth street, New York city, to whom all replies should be sent.

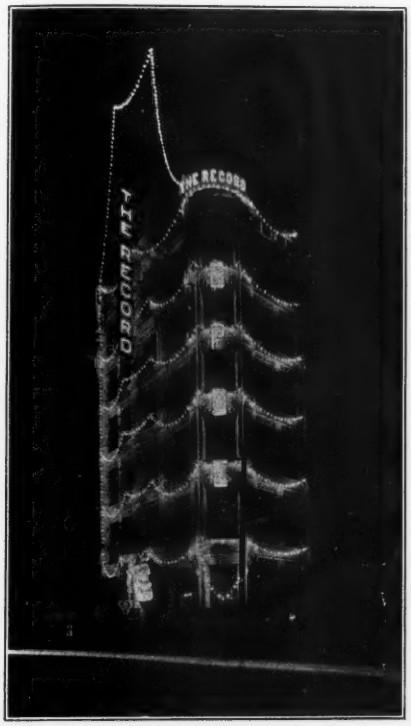
Electrical Display in Philadelphia.

During the annual reunion of the Elks, which was held in Philadelphia, July 15-20, an elaborate electrical display took place, which was said to be one of the finest and most complete displays of this kind which has ever been made; exception of course, being made to the large expositions held in this country, where more permanent methods were possible. For a temporary display to be in use for but one week, that recently made in Philadelphia was most elaborate.

When it was proposed that the coming of the Elks be made the occasion of a special effort to produce a magnificent display, the response of the Philadelphia merchants was immediate and generous. The opportunity of showing the enterprising spirit of the city was seized upon, and the display of bunting, flags, and emblems of every description was elaborate and costly. The main streets of the city, and even certain of the streets in the outlying districts, were gorgeously decorated. However, in comparison with these decorations,



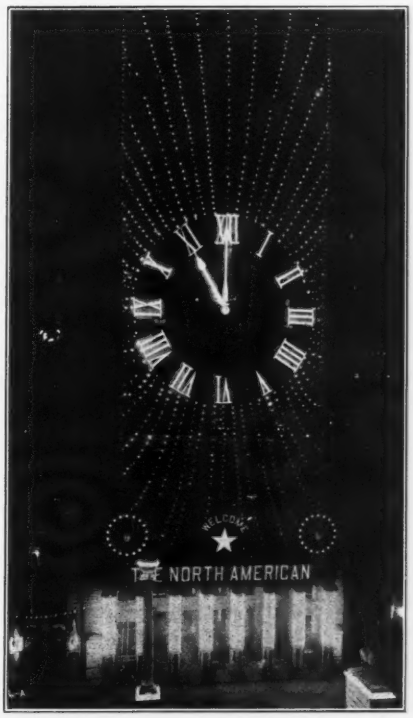
The Elks' Convention, Philadelphia, Pa., July 15-20. The Electrical Decorations of the Philadelphia Electric Company; 3,500 Incandescent and Fourteen Nernst Lamps.



THE ELKS' CONVENTION, PHILADELPHIA, PA., JULY 15-20. THE RECORD BUILDING; 1,500 INCANDESCENT LAMPS.

the electrical display was far more effective. This attracted many thousands of people to that part of the city where it was in operation every night during the week.

One of the moving spirits of this display was the Philadelphia Electric Company, which made great effort to work up public interest, and to create a display which would not only reflect credit upon the city, but which would outshine all previous efforts. For many weeks before the convening of the Elks, the Electric Company was talking about the electrical display to its customers, and in this way a good deal of interest was aroused. About three weeks before the convention, the company began a campaign of advertising in the daily papers; this advertising being intended to arouse the civic pride of Philadelphians and to bring to them the realization of the opportunity for advertising offered by the influx of several hundred thousand visitors to Philadelphia and to pointing out that the most effective way was by means of an electrical display. This was followed by a postal card campaign, conducted along the same lines,



THE ELKS' CONVENTION, PHILADELPHIA, PA., JULY 15-20. THE NORTH AMERICAN BUILDING; 16,000 INCANDESCENT LAMPS.

COURT OF HONOR, LOOKING SOUTH. CELEBRATION IN HONOR OF ELKS' CONVENTION, PHILADELPHIA, PA., JULY 15-20.

and the interest in the matter maintained until the solicitors were able to make their rounds. The result of this was somewhat unexpected, as the demand for electrical supplies became so great that the stock of the city was exhausted in certain lines several days before the convention met. It was estimated that there were used in producing the electrical display, between 300,000 and 500,000 lamps. The Philadelphia Electric Company, however, estimate from its evening loads that there were 300,000 as a maximum.

Many of the displays made were very artistic and effective. This is well illustrated by the accompanying photographs, one of which shows the decorations on the City Hall, where the Court of Honor was established. The court extended for a distance of six city blocks, the City Hall being in the centre. It was a central point, to which the crowds were attracted. The Court of Honor ran north and south on Broad street; to the east of the City Hall, Market street was ablaze with lights, and the large department stores vied with each other in their exhibits.

Another one of the illustrations shows the decorations of the Philadelphia Electric Company's building; while the other two show striking effects. About three-fourths of the large electric load created by these decorations was carried by the Philadelphia Electric Company, it is said, without any hitch and with no interference with the regular service.

A feature of the week was the offering of prizes by the Elks' convention committee for the best electrical display. In awarding these prizes, the extent of the display, as well as the artistic character, carried weight. As an indication of the size of the exhibits, the following may be mentioned: on the North American Building, there was 16,000 lamps; Lit Brothers, 12,000 lamps; Strawbridge & Clothier, N. Snellenberg & Co., each had 15,000 lamps. John Wanamaker, 6,000 lamps; Philadelphia Electric Company, 3,500 lamps, and a number of other buildings had several thousand lamps apiece. On the City Hall there were 19,000 lamps, and in the Court of Honor, 13,500 lamps. The Record Building, shown among the illustrations, was decorated with 1,500 lamps.

Electric Trains on the New Haven Road.

On Wednesday, July 24, the electric service of the New York, New Haven & Hartford Railroad Company, leading into New York city, was inaugurated. This completes the electrification of the railroad systems entering into the borough of Manhattan, and removes the steam locomotive from these tracks.

At the present time the New Haven system is operated only from New Rochelle. In a few days it is expected that the electric zone of this road will be extended to Port Chester, and by September 1 electric trains will be running between New York and Stamford, Ct. The last of the electric locomotives, which were furnished by the Westinghouse Electric and Manufacturing Company, has been delivered, the railroad company now having thirty-five of these locomotives, each rated at 1,000 horse-power.

The putting into service of this system marks an important epoch in the electrification of steam railroads, for this is the first large single-phase system to be installed. There have been several single-phase roads put into service within the last year or two, but these have all been of the interurban type. The New Haven system, as is well known, is one of the large railroad systems of the eastern states, and the selection of the single-phase system for this work marks a departure from all previous undertakings. This road was forced by legislative action to abandon the steam locomotive within the city of New York. Several years ago it decided upon electrification, and last year selected the single-phase system, the contract being given to the Westinghouse Electric and Manufacturing Company. The same company was also given the contract for the power-house equipment. The power-house is located at Stamford, and is equipped with Westinghouse steam turbo-generators.

Since April 18 the single-phase system has been practically complete, and instruction trains have been in operation. The opening of the service to the public was delayed, however, until arrangements could be completed with the New York Central & Hudson River Railroad for the purchase of power used while running over the latter road's tracks in New York city.

The current for the new system is transmitted by an overhead line from New Rochelle to the junction of the New York Central's tracks near Woodlawn. From here power is taken from the latter company's third-rail.

The New Haven trains are made up of regular passenger coaches coupled to an electric locomotive and speeds of seventy-five miles an hour are attainable. The first train left New Rochelle at 7.50 A. M., Wednesday, arriving at the Grand Central station at 8.28. The running is said to have been very smooth, and the locomotive easily maintained schedule time.

The New Haven road has not yet bought any motor-car equipments, though it is said that this may be done later on. All the trains, for the present, will be drawn by the locomotives.

Application for Reduction in the Special Tax by the Brooklyn Rapid Transit Company.

Judge Blatzek in the Supreme Court of New York has granted a writ of *certiorari* directing the state board of tax commission of New York to show cause upon August 25 why the final assessment they fixed recently on the value of the special franchise held by the constituent roads of the Brooklyn Rapid Transit system should not be reduced as excessive and illegal.

The total reduction asked for is $43,666,644.38. The companies concerned are the Brooklyn Union Electric Railway, the Brooklyn Heights Railroad, the Nassau Electric Railway, the Coney Island & Gravesend Railway, the South Brooklyn Railway (as lessee of the Prospect Park & Coney Island Railway Company), the Brooklyn Heights Railroad Company (as lessee of the Brooklyn City Railroad Company), and the Brooklyn, Queens County & Suburban Railroad Company. The writs were granted on the application of T. S. Williams, who is president of each of the seven corporations.

Mr. Williams declares that the assessments are not only exorbitant but intolerable, and that the burdens placed by them on the companies are such that unless reduced it will absorb all the net earnings. He pointed out that in the case of the Brooklyn Union Railway, the total taxation of all kind, state and local, which this company has to pay, amounts to more than sixty-one per cent of the total net earnings, and the condition in the case of the other companies is similar. He called attention to the fact that the total assessment for the special franchise of the companies constituting the Brooklyn Rapid Transit Company amounts to $54,436,000. This is an increase over the assessment for last year of $20,905,000, and the comparison of the companies' earnings with those of the previous year does not justify any such increase. Mr. Williams asserts that the system of assessing special franchises is manifestly unfair as there is no adequate stand of comparison established, nor is any rule laid down for the guidance of the tax commissioners. He urges that the assessment must be reduced if the corporations are to continue to earn profits or pay dividends.

"Good Advice to Trade Papers."

In an article entitled "Good Advice to Trade Papers," J. C. McQuiston, manager of the Westinghouse Companies' Publishing Department, presents some interesting and instructive views in the July issue of *Profitable Advertising*. The following abstract will be of particular interest to manufacturers in the electrical field:

"As to the editorial and reading matter that should be published in any technical or trade paper, this is and should be beyond the control or suggestion of the advertising man representing the manufactory or the advertising manager of the paper. The sole aim should be to handle the subject in such a way that the readers of the paper may be kept thoroughly alive as to the progress being made in the particular line in which the paper circulates. Manufacturers can, in many ways, assist in gathering matter for the paper, and are usually very glad to thus assist. In all such matters the personality of the editor should be seen in the finished matter as it appears in the paper. Statements should be strong and unbiased, and presented in such a way as to elicit confidence on the part of all who read them. The placing of advertisements in technical and trade papers should not entitle the advertiser to space in the editorial or reading columns, unless merited through the matter presented. Neither should the description of a plant in which the apparatus of a manufacturer is referred to in any way obligate the manufacturer of that apparatus to take space in that issue or in any future issue. A broad spirit along this line will tend to strengthen the technical and trade papers among manufacturers."

The Dean Automatic Telegraph System.

Announcement is made that Robert L. Dean, of Kansas City, Mo., has recently invented an automatic telegraph system for which a number of remarkable features are claimed. The basic principle of the Dean telegraph system is radically different from hitherto exploited automatic systems. The message is not transmitted from a perforated tape nor received on a tape, but is prepared in page form with an ordinary typewriter, using special type, with dots and dashes above and below each letter. The dots are so arranged that positive and negative impulses are sent over the wire when desired. A three-wire motor-generator is employed for furnishing the alternative impulses.

The sheet is embossed and typewritten at the same time. If a mistake is made, the operator erases the emboss and rewrites the word in which the mistake has occurred. It is stated that after the letter is prepared for automatic transmission it may be fed through the transmitting instrument at a speed of from 300 to 500 words per minute and received at a receiving station in Gothic letters, in page form. In the sending instrument two styluses are used to send positive and negative signals. These styluses are made of sapphire, ground to a certain angle suitable for the work which passes over the embosses, and close a metallic circuit.

The general construction of the receiving instrument is the same as the sending instrument, with the exception that it has a printer instead of a stylus. The printer consists of two characters, with which the entire alphabet is produced. One character is actuated by a positive impulse, and the other by a negative impulse. A polar relay of special design, having two armatures, is employed. One armature controls one character, and the other armature controls the other character.

It is stated that this system is now doing commercial work between Kansas City and St. Louis, Mo., on a phantom circuit of 320 miles.

The High-Resistance Contact Thermo-Electric Detector for Electrical Waves.

If two metals standing far apart in the thermo-electric series be so brought in contact that their contact resistance is sufficiently high, and if the surfaces of the metals are of such a nature that heat is not conducted away too rapidly from the point of contact, then the passage of electrical oscillations through the junction will produce direct electromotive forces, which may be detected in a galvanometer or telephone in series with the thermo element. This principle has been applied by L. W. Austin, who finds it extremely simple in practice; but there are few pairs of metals only which give suitable contact conditions. If the contact be of too low resistance, the heating is insufficient, and if too loose, as in the coherer, the action is irregular, and the instrument less sensitive. On account of its extreme position in the thermo-electric series, tellurium seems desirable as one of the metals, and it was tried with a large number of others. Fair results were obtained with several of the more easily oxidizable metals, and also with carbon, but with all these the action was irregular and adjustment difficult. Aluminum was finally fixed upon as being the most sensitive and by far the most reliable among the common metals. Silicon also proved satisfactory. The instrument may be made in various forms. In one of these a bead of tellurium mounted on a brass wire was pressed by a spring against the point of a sharpened aluminum rod, the pressure being adjustable by means of a screw. This device is connected in the oscillatory circuit, and is shunted by a telephone. It was found to be about as sensitive as the electrolytic receiver, being somewhat less sensitive than the Wollaston type, but rather more so than the small platinum wire electrode type. The telephone receiver employed had a resistance of about 1,200 ohms.—*Abstracted from the Physical Review (Lancaster), June.*

The Radioactivity of Lead and Other Metals.

Experiments have been carried out recently by J. C. McLennan, according to *Nature* (London) July 11, on the radioactivity of lead and other materials. Values were found which did not agree with those of previous observers. This was particularly true of lead. Zinc also showed variations from previously found values. The observations were made by determining the conductivity of air when confined in vessels made of these metals. From measurements made of the γ rays from the radium produced in air confined in a lead cylinder, first when unlined, and second when lined with thin sheet aluminum, it was found that the ionization was one-half that obtained with the excited secondary radiation. On the other hand, with an aluminum cylinder, the ionization due to the secondary radiation was found to be approximately one-half that produced by the γ rays. These differences can only be explained by differences in the secondary radiation excited in the two metals. This result, combined with the observed differences in the conductivity of air enclosed in vessels made of different samples of lead, is due to the presence of active impurities in it, and not to the existence of any intrinsic activity possessed by the metal. In this connection, it is pointed out that Elster and Geitel have recently prepared an extract from commercial lead oxide which consists of an active substance thought possibly to be radium F.

EXPERIMENTS WITH CONCRETE TELEGRAPH POLES.[1]

BY G. A. CELLAR.

So far as the writer has ascertained, the preservation of steel imbedded in properly constructed concrete is perfect. Concrete not only does not disintegrate, but hardens and improves with age. Therefore, a structure of reinforced concrete has a life that is practically unlimited, and a telegraph pole made of reinforced concrete ought for many generations to endure and answer the purpose for which it is erected. The location of pole lines along railroad rights of way will in the future permit the use of shorter poles for supporting the wires nearer the ground than has been practicable heretofore, because the rights of way of the railroads are better policed now than in the past, and in the future will be much more safely guarded. The time will soon come when persons not employed on the railroads, or whose duties do not require them to be on railroad property, will not be allowed on the rights of way of any railroad company. In England and on the Continent, where trespassing is not permitted, it is the practice to use very much shorter poles and place the wires nearer the ground.

The use of concrete for the manufacture of telegraph poles is not new. As nearly as I have been able to ascertain, the first concrete poles were designed by Colonel G. M. Totten, chief engineer of the Panama Railroad Company, at a date uncertain, but probably about 1856, the road having been put into operation in that year. These poles were cone-shaped, twelve feet long, with a diameter of from twelve to fifteen inches at the base and from six to eight inches at the top. The wires were supported by iron brackets, which were fastened to the poles by wrought-iron bands passing around them and around the poles near the top. The proportions of the ingredients used in the manufacture of these poles is not obtainable, but the strength to resist strains was so inadequate that means were sought to overcome this fault, and the poles were a few years later replaced from time to time by the first reinforced concrete poles of which record is known, the reinforcement consisting of three-inch by three-inch pine cores, extending throughout the length of the poles. The concrete poles, it is understood, were used because the available wooden poles were very short-lived, by reason of the ravages of insects. The poles with wooden reinforcement evidently were not attacked by the ants soon enough to prevent the cores from swelling and cracking the concrete, so that the first pattern of reinforced poles was not an appreciable improvement over the solid pole. After being used for a few years, the disruption of both classes of poles was such that they were practically abandoned, they having been replaced as occasion required by other patterns until, in 1888, there were only about twenty of the original poles standing, one or two of which still remain erect on the line of that road.

The "Geological Survey of Ohio," Fourth Series, Bulletin 2 (1904), entitled "Uses of Hydraulic Cement," by Professor Frank Harvey Eno, of the Ohio State University, presents in an article entitled "Cement Telegraph Poles," an item of some interest, describing cement butts for wood poles that have rotted off, observing that when a pole has to be replaced, often only the part setting in the ground has deteriorated, and, while in some country districts the pole may be cut off and reset, there are many poles that must be replaced altogether, thus losing the most of the pole. To meet this contingency, a cement base has been devised, octagonal in shape, with four iron strips bolted to opposite faces, extending a foot or more above the concrete. In installing this concrete base, the rotten pole is sawed off, the lower end swung a little to one side, the cement base put in the place of the rotten stump and the pole is then swung into the socket formed by the iron strips, and securely bolted. The pole when thus equipped is alleged to be better than new. In restumping in the manner just outlined, no wiring need be touched nor telegraph communication interfered with in the least. Another feature of the use of these cement butts is, that when a pole has deteriorated beyond the point of usefulness, and has to be replaced, a pole five feet shorter can be furnished, thus materially reducing the cost. The above-mentioned article states that these butts had been in use for three years, and were giving good satisfaction. The practice of restumping is largely followed in the present day, except that stumps of wood are used instead of those of concrete.

The experience of late years on all lines of railroad is, that the expansion of track and other improvements have made it necessary to move to new right of way lines so many telegraph poles that, in planning for a pole of infinite life, it would be better, if possible, to procure a type which would be secure without the foundation which would render its location when once set up a permanent fixture, and this type would be preferable to the fixed type.

(*a*) Because of its smaller cost to construct;

(*b*) Because of its smaller cost to set up in the line, and

(*c*) Because it will be easily removable to a new location.

The second question was decided in favor of the manufacture of poles in yards, because their construction at the points at which they are to be set involves the transportation to these points of not only the solid materials to be used in their manufacture, and shelter for these materials, but also the water, which is not ordinarily available, and the forms. In fact, a very considerable additional physical property in the crude materials proportionate to the smaller sum total of the finished product.

On busy railroads, construction at the point of settling would involve the assembling of the apparatus on a car, the use of motive power, and the obstruction of the main track to a certain degree. This being the case, the alternate plan does not require any more apparatus or crew, will not require the services of a locomotive and crew as long, or for any longer time, than the plan of making the poles at the place where they are to be set up; but it involves in addition, perhaps, the use of a derrick to be mounted on a car, the beam of which shall have sufficient radius to reach the line on which the poles are to be set. The procedure to be followed would then preferably be to manufacture the poles in a yard and have them thoroughly seasoned there before moving. In preparing for distribution, they should each be tagged or otherwise have a designation or location attached to each one, indicating the exact site in which the surveyor or inspector has designated each to be set on account of the necessities for grading the line. The poles should then be loaded by the use of the yard derrick or a derrick car, be taken out by a train, and by the crew of the derrick set up in their permanent places in the line, in holes previously dug for their reception. This plan will require very little, if any more obstruction of the main track than the stoppages requisite for the unloading of seasoned cedar poles.

On this basis, we proceeded to make experiments, first in design, and later in various and many patterns. In the working out of the plans for the requisite strength with the minimum of weight, the two hollow poles referred to in detail hereafter were made. The results of the

[1] Abstract of a paper read before the convention of the Association of Railway Telegraph Superintendents, Atlantic City, N. J., June 19-21.

tests are given in this paper as an example of progress, and are not to be taken as the best form for adoption, but quite the contrary. One of the patterns was square in section, with the corners chamfered off; the other, octagonal in section, and the hollow space extending from the base for about two-thirds of the length of the pole, the upper third being solid and the walls of the lower two-thirds being from one and three-fourths inches to three inches thick. These poles weighed approximately 3,500 pounds, and were calculated to withstand any stress in any direction that could possibly be imposed upon them by a line of fifty wires, each wire coated with sufficient ice to make it one inch in diameter. The test was made in connection with two carefully selected cedar poles of the same length (thirty feet), and all were set in concrete, the bases being three feet by three feet by five feet deep.

Just within the outer surface, the walls of the concrete poles were reinforced with iron rods, which consisted of four three-quarters-inch round bars, each twenty-four feet long, and four five-eighths-inch round bars of the same length. The poles were eight inches in diameter at the top and thirteen inches at the base, having a taper of one inch to each five feet. Galvanized iron steps were screwed into wooden blocks molded into the concrete, and holes were left for through bolts for supporting the cross-arms. The cross-arm braces were attached to the arms by through bolts in the same manner and fastened to the poles with ordinary lag bolts driven into wooden plugs which were placed in the concrete at the proper places. The concrete poles were set to a depth of five feet in concrete with the two white cedar poles of practically the same dimensions, and, after standing long enough to permit the cement to become solid, they were tested in turn in the following manner:

An iron clevis was placed around the pole to be tested ten inches from the top, to which a wire rope was attached, leading over a pulley placed at the same height and at an equal distance from the pole so as to form a right angle, and fastened to a differential pulley block which was attached to a laboratory weighing machine.

The results are fully shown in the following tables.

After the cement poles had been broken the reinforcement so held them that it required almost the breaking pressure to further deflect them from their slightly inclined position. The wooden poles, under strain, presented the form of an arch before breaking, and when they gave way were fractured completely; but these features were lacking in the cement poles, which were very firm and did not give until they began to crush at the ground line.

The mixture used in these cement poles was 1 to 3. They were constructed in cold weather, and, through some mischance, at the last moment we were unable to get suitable gravel. Pole No. 1 was found to have a defect in the casting, which is believed to be the cause of its early rupture. Pole No. 2 gave a very much better result.

The consensus of opinion seems to be that a 1-2-4 mixture is the best for use in this class of construction, and, while the experiments related above were entirely satisfactory in the development of the problem, the hollow pattern is not considered to be the highest type desirable; that is, to combine sufficient strength with the least possible weight, in order to obtain ease in handling, and that the removal from place to place may be readily feasible.

To fulfil these requirements, the pole should be made with a superstructure of somewhat greater strength than the wires which it is required to support, joined to sufficiently added strength by reinforcement and added area in the base, especially at the ground line; and the base should be reinforced in the most effective way to withstand the extreme pressure at the point of fulcrum.

These conditions are all capable of mathematical computation, and if fulfilled, will give a product comparatively easy of manufacture, of reasonable cost, of greater tensile strength than the poles now in use, and extremely high durability.

POLE NO. 1—CONCRETE, OCTAGONAL.

Length.	Base Diameter.	Top Diameter.	Depth in Concrete Anchorage.	Distance from Point of Fulcrum to Point of Load.
30 ft.	14 in.	8 in.	5 ft.	24 ft. 2 in.

TEST NO. 1.

Deflection at Top.	Load, Pounds.		Deflection 12 Inches Above Ground Line.	Time.
3¼ in.	1,830		1/32 in.	3.17
5¾ "	2,230		1/16 "	3.18

TEST NO. 2.

½ in.	50	Temporary deflection, ½ in.	1/32 in.	
8 "	2,630		1/8 "	3.19
11¾ "	3,030	Cracks Nos. 1 and 2.	3/16 "	3.20

TEST NO. 3.

1¼ in.	50	Temporary deflection.	1/16 in.	
14¼ "	3,430	Cracks Nos. 3 and 4.	¼ "	3.24
18 "	3,210	Crack No. 5 and crushed bolt.	3/8 "	3.25
25½ "	3,150	Pole broke at ground level.	¾ "	3.26

POLE NO. 2—CONCRETE, SQUARE.

Length.	Base Diameter.	Top Diameter.	Depth in Concrete Anchorage.	Distance from Point of Fulcrum to Point of Load.
30 ft.	13 in.	7 in.	5 ft.	24 ft. 2 in.

TEST NO. 1.

Deflection at Top.	Load, Pounds.		Time.
¾ in.	50		2.02
2½ "	1,830		2.04
3½ "	2,230		2.08

TEST NO. 2.

¾ in.	50	Temporary deflection,	1 in.	
4 9/16 "	2,630			2.10
8½ "	3,030		1/16 "	2.11

TEST NO. 3.

3½ in.	50			
31 "	3,290			
34½ "	3,430	Crack No. 1.	1/8 in.	2.14

TEST NO. 4.

21¼ in.	50	Temporary deflection.	22 in.	
39 "	3,690	Cracks Nos. 2, 3 and 4. Pole crushed crack at ground level.		

POLE NO. 3—WHITE CEDAR.

Length.	Base Diameter.	Top Diameter.	Depth in Concrete Anchorage.	Distance from Point of Fulcrum to Point of Load.
30 ft.	14 in.	8 in.	5 ft.	24 ft. 2 in.

Deflection at Top.	Load, Pounds.		Time.
14 in.	172		
37 "	2,230		
47 "	2,530	Pole broke.	11.03

POLE NO. 4—WHITE CEDAR.

Length.	Base Diameter.	Top Diameter.	Depth in Concrete Anchorage.	Distance from Point of Fulcrum to Point of Load.
30 ft.	14 in.	8 in.	5 ft.	24 ft. 2 in.

Deflection at Top.	Load, Pounds.		Time.
20 in.	1,830		11.50
22¼ "	2,230		11.51
29 "	2,630		11.52
35 "	2,870	First crack.	11.53
36½ "	2,950		11.54
38½ "	3,030		11.55
50 "	3,370		11.56
56 "	3,430		11.57
66 "	3,494	Pole broke.	12.00

The argument has been advanced that the reinforced cement pole would be very liable to damage or disruption by shock, but the fact that concrete piles, both of hollow and solid designs, are driven by pile-drivers, and especially with the knowledge of the experiments at Rochester, which showed that the poles, even after they had been fractured at the surface of the foundations, required an exteremely heavy pressure to produce further deflection from the positions at the time of the fractures—in other words, that they were almost as stiff as when they stood upright, and continued to be so throughout the entire test—I feel that any alarm at the prospect of damage by collision between the pole and anything less than a movable object that would destroy any pole of natural or manufactured composition is unfounded.

As to the insulating qualities of the concrete pole, it is hardly necessary to mention that they are superior to those demonstrated in any other pole manufactured in this country.

It is expected that within a few weeks some steel poles with just enough concrete to serve as a preservative, and other steel poles covered experimentally with a cement paint, will be set in the line along the Fort Wayne road. Experiments have also been made with several sizes of reinforced concrete cross-arms with very satisfactory results.

The tests at Rochester, Pa., were made by Robert A. Cummings, who built the poles for us in his yards at that point.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

An Electrical Percussion Drill.

In an account of the Sandycroft Foundry Company's works at Chester, England, which is given here, there is a description of an interesting electrical percussion rock drill, which is one of the specialties of this company. In this apparatus the heavy iron core of the drill is given a reciprocating movement by means of a pair of solenoids, which are energized by a pulsating current of peculiar wave-form and low-frequency, obtained by a specially designed generator. The moving part of the drill consists of a solid steel plunger surrounded by two coils of wire, through which the currents pass. These pull the core backwards and forwards, the back stroke being checked by a helical spring, which absorbs surplus energy, returning it to the drill as its direction is reversed. The dynamo furnishing current for this drill may be used either as a generator or as a rotary converter, but when used as a generator, about twice the number of drills can be operated. The machine has four poles, though but one cycle is produced during each revolution. The armature is provided with an ordinary commutator, and tappings are taken from this at four points in the usual way as for a single-phase rotary converter. From these connections are run to two segments of a four-part commutator with two brushes. The other two segments of this commutator are connected to slip rings. The action of this four-part commutator is to take current during two successive quarter revolutions from the continuous and alternating sides in turn, so that the result is a wave lasting over half a revolution, with a flat top given during that quarter of the revolution when the continuous current is being taken from the armature. A divided ring is placed on the shaft, which serves to make connection during alternate half-revolutions to the two sections of the coil in the drill. These coils have a common return, so that but three leads are necessary.—*Abstracted from Electrical Engineering (London), July* 11.

On the Loss of Energy in the Dielectric of Cables and Condensers.

In this section of his study on the dielectric loss of cables and condensers, Dr. Bruno Monasch gives his conclusions. He describes briefly some of the measurements made by the methods described in the issue of the ELECTRICAL REVIEW for July 20, and gives the results of measurements with a number of condensers. He concludes that in all the dielectrics tested, including various kinds of glass, ebonite, impregnated paper, rubber, impregnated jute, the square law is obeyed with perfect accuracy if the voltage alone be varied. Apparent digressions from this law result as soon as another quantity by which the loss is influenced, as, for example, temperature, be varied. In the dielectrics, glass and ebonite, the loss increases appreciably even with a small rise of temperature. In the cables tested, however, the departure from the square law caused by rise of temperature originating in the loss itself does not take place except above the working voltage. The loss thus increases strictly in proportion to the square of the voltage in these cables also. A further apparent digression from the square law is exhibited by the loss in a condenser at high voltages, if brush discharges take place. In this case the loss increases much more quickly than the square of the voltage. The energy loss in the dielectric is proportional to the capacity, and may be considered as proportional to the frequency through the range of frequencies used for technical purposes. Although, for these tests, only dielectrics with comparatively small loss were selected, the amount of loss found exhibits rather considerable differences in the different materials. Especially in glass, great variation in the loss is found in different kinds. Flint glass showed a smaller loss than any other dielectric, with the exception of paraffine. The loss in a cable insulated with rubber or impregnated jute was but slightly greater than that with flint glass. As the loss follows strictly the square law, there is no reason for making determinations of dielectric loss at high voltages, and the method described appears suitable for technical measurements of loss in cables. Moreover, it might replace advantageously the insulation test on alternating-current cables. In extensive high-tension cable networks the amount of energy wasted in the dielectric is by no means negligible. In the case of short or medium lengths, it causes by far the greater part of the no-load loss, and only in very long uninterrupted cable lines can it be neglected in comparison with the copper loss.—*Abstracted from the Electrician (London), July* 12.

The Use of Lighting Mains for Telephonic Communication.

The desirability of having telephone communication between different stations on an electrical supply system, without being dependent upon the local telephone company, has led the Austrian Allgemeine Elektricitäts Gesellschaft to devise a system, which has been in use for some time in Vienna. Private lines might be employed, but this can be done cheaply only when the supply is by means of overhead lines. When underground cables are used for distribution the only economical method of obtaining private telephone connection is to use the existing cables and pilot wires for this purpose. Usually there are not enough free pilot wires to make up circuits, and it is almost essential to bring in the main cables as well, especially as the use of pilot wires of different cables as lead and return is unsatisfactory, owing to the high inductance introduced by the iron armorings. The remaining arrangement is to use the main cable as one lead, and the pilot wire of the same cable as the other. The connections for this purpose will be different, according to whether the pilot wire is an idle one or one already used for voltage regulation. Calling-up is accomplished by opening the connections between the pilot wire and one cable, and making the connection to a second suitable cable through a resistance; a calling battery is superfluous. When the pilot wires are all used for pressure measurements, the telephone apparatus is not connected directly to the mains, but through a small transformer. The pilot wire can then be permanently connected to the cable at one end, as required for voltage tests. Induction bells must be used, of course, for calling up with this arrangement. This method has been found satisfactory in practice, although some difficulty was at first experienced in obtaining sufficiently efficient transformers. This was overcome by employing transformers made of an iron having low internal losses.—*Abstracted from the Electrical Engineer (London), July* 5.

Pacific Light and Power Company's Plants and Substations.

Brief descriptions are given here of the generating plants and substations operated by the Pacific Light and Power Company in southern California. The San Bernardino Gas and Electric Company has three water-power plants and two steam plants. The former are in the Santa Ana Cañon, High Grove and West Riverside, while the latter are in San Bernardino. One of the latter is a substation operated in conjunction with a gas plant supplying gas to the town and vicinity. The other of the San Bernardino stations was until recently operated by water. This was destroyed by fire, and has been replaced by a steam plant. This contains one 150-kilowatt, three-phase, 2,200-volt generator driven from a tandem-compound, high-speed engine. The High Grove power-house has a small generating equipment, but nevertheless is one of the most important on the system, as it supplies light and power to a district with a wider range of industrial activities than any other in the southern part of the state. Four miles above the power-house a dam was thrown across Warm Creek. Water is conducted from this by a wooden flume to the power-house, where there are two fifteen-inch cylinder gate turbines driving a 150-kilowatt, three-phase, 2,200-volt, fifty-cycle generator. There are two fifteen-kilowatt oil-insulated transformers, which step the pressure up to 15,000 volts for transmission. This plant is one of the oldest hydroelectric plants in the state. The Riverside power-house is twelve miles west of Riverside, on the south bank of the Santa Ana river. This is one of the newest of the company's plants. Water is diverted from the river by means of a canal six miles long. The power-house contains two twenty-two-inch, high-pressure turbines running at 500 revolutions, developing 1,000 horse-power. These are direct-connected to two 300-kilowatt, fifty-cycle, three-phase, 10,500-volt generators of the revolving-field type. By means of water-cooled, oil-insulated transformers the pressure is stepped up to 10,500 and 17,500 volts for distribution. The Kern river substation is a modern three-story building of reinforced concrete, fitted with the latest type of apparatus. Current is received at 60,000 volts, and stepped down to 15,000 by means of oil-cooled, oil-insulated transformers, being supplied at the latter pressure for local distribution. Power is supplied from this station to the Los Angeles Railway Company by means of a special 15,000-volt transmission line. The steam plant in Los Angeles was started in the last of the nineties, and has been added to yearly since. It contains one 2,400-horse-power condensing engine direct-connected to a 1,500-kilowatt, two-phase, 2,400-volt alternator; a second steam engine rated at 1,150 horse-power connected to a 500-kilowatt alternator of the same general type; a 700-horse-power, non-condensing engine belted to a 300-kilowatt, 2,400-volt alternator. There are, in addition, two 300-kilowatt, 2,400-volt alternators, one belt-driven from a 600-horse-power horizontal engine, the other driven from a similar engine by means of ropes. There are a number of smaller machines for supplying power to the station and the exciting current. Power from this station is supplied to a number of substations throughout the city, the transmission being by means of 15,000-volt, three-phase lines. The oldest of these is the South Pasadena substation, installed in 1899. This station was reconstructed last year.—*Abstracted from the Journal of Electricity, Power and Gas (San Francisco), July* 13.

The Stratford Power Station of the Great Eastern Railway, England.

A description is given here of the turbo-generator station recently completed and put into operation by the Great Eastern Railway Company, at Stratford, England. This station supplies power for the railway's shops and stations, taking the place of several older generating stations. The company has already a plant at Norton Folgate, where reciprocating engines are employed. This station will be suppressed, and it becomes unnecessary for the railway company to draw power from the Liverpool street station or the Bishopsgate station. The new station will supply power to the railway company's locomotive shops at Stratford, to printing works at Canning Town, car shops at Temple Mills, besides a good deal of machinery in the freight yards. The new power-house consists of two steel-frame structures side by side, one housing the turbines and the other the boilers. Convenient coal-handling arrangements have been provided. The boilers are of the Galloway type, provided with a superheater for superheating the temperature of the steam 100 degrees Fahrenheit, and a Green economizer. Induced draft is provided by means of four motor-driven fans. The steam and feed pipes are of solid drawn steel with welded flanges. The generating plant comprises three 1,000-kilowatt turbo-alternators running at 1,500 revolutions a minute, delivering three-phase current at 6,600 volts pressure, fifty cycles. These sets were furnished by C. A. Parsons & Company. The alternators are star-connected with neutrals earthed through suitable resistances. Each machine has a small sixty-volt, two-pole exciter mounted on an extension of the shaft. The turbine units are arranged longitudinally down the side of the engine room, their respective condensers being placed in open pits in the centre of the building. The switchboard is placed on the far side of the room. The condensers are of the surface type, fitted with Parsons vacuum augmenter. Water for feed and condensing purposes is secured from a well by means of an air-lift. The high-tension switching apparatus comprises an upper and lower row of oil switches linked together by ring bus-bars. The switch-panels are situated on a level with the upper row of oil switches, and the operating gallery overlooks the whole of the running plant. The ring bus-bars are divided into six sections by non-automatic oil switches. The middle, upper and lower sections are reserved to generators and work shops. Each substation is practically supplied through duplicate feeders, one connected to a bus-bar section in the upper row, and one to a corresponding section in the lower row. This facilitates the division of the load between lighting and power services, and also makes possible the isolating of any section of bus-bar for working upon it. The generators are provided with a triple-pole reverse-current relay of the differential type. All feeders have direct-acting trip gear supplied from series transformers with secondary fuses in parallel with the trip coils to give the time-limit effect. These avoid the complications of intermediate time-limit relays in the current transformers and the trip gear. The oil switches and bus-bars are located in a two-story cellular concrete structure built up from the engine-room floor. All the high-pressure connections are of bare copper rod, and all connections are uniformly colored blue, red and yellow, to distinguish the phases. The lighting pressure is controlled by means of a Tirrill regulator working upon the exciter fields. The distributing system consists for the most part of cables laid solid in wood troughing, and covered with tiles. In confined places, such as over bridges and viaducts, they are laid in square cast iron troughs on a layer of felt, and bracketed to the walls.—*Abstracted from the Electrical Review (London), July* 12.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

KELVIN BALANCE TYPE OF PORTABLE INDICATING METER.

BY H. W. YOUNG.

The Kelvin laboratory balances have long been recognized standards for use in standardizing laboratories where the greatest precision in measurements is necessary and the extension of this design for use in portable service will be appreciated by those requiring standards of the highest accuracy. These portable balances, which are made by the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., in the following forms: voltmeters, milammeter and combination lamp testing volt-wattmeters, can be used interchangeably upon alternating current or direct current and are unaffected by stray field effects.

The meters are of the Kelvin balance dynamometer "zero reading" type, employing fixed and movable coils so distributed as to give an astatically arranged measuring system.

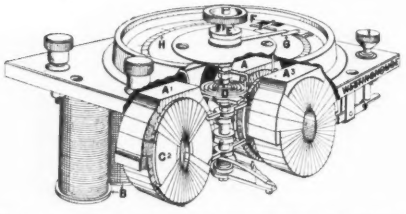


FIG. 1.—GENERAL ARRANGEMENT OF VOLTMETER MEASURING ELEMENTS.

Fig. 1 illustrates the general arrangement of the voltmeter measuring elements, one coil, A_2, being removed, the various parts being as follows: A, A_1, A_2, A_3, stationary measuring coils; C_1, C_2, movable measuring coils; B, non-inductive resistance; D, control or restraining spring; E, torsional head controlling restraining spring; F, indicating pointer attached to movable element; G, indicating pointer attached to torsional head; H, 300 degree scale; I, contact and moving locking key.

Fig. 2 illustrates the relative positions and connections of the elements shown in Fig. 1. The entire measuring coil system, A, A_1, A_2, A_3, C_1 and C_2 is connected in series and with part of the resistance B when meter is to be used at the lower full scale value, and with all of the resistance when meter is to be used at the higher full scale values.

The meter depends for its operation upon the electromagnetic action between

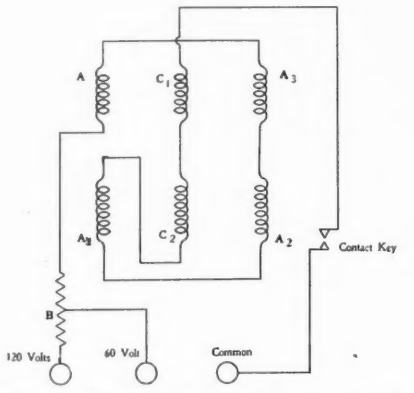


FIG. 2.—RELATIVE POSITIONS AND CONNECTIONS OF ELEMENTS.

the fixed and moving coils as follows: with current flowing through coils, coil C_1 is attracted by coil A and repelled by coil A_3; coil C_2 is attracted by coil A_2 and repelled by coil A_1. The resulting electromagnetic action deflects pointer L to the left of zero and in order to bring it back to zero it is necessary to twist the torsional control head, to which the restraining spring is secured, until the movable system is brought back to its initial position and the pointer L indicates zero, thus balancing the opposing forces. The position of

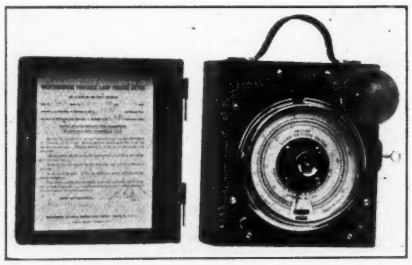


FIG. 3.—PORTABLE BALANCE AND CARRYING CASE.

pointer L then indicates on a scale the value sought.

The moving element of the instrument consists of two light-weight coils mounted on either end of a common support which also carries the indicating pointer and control spring. The entire movement is supported by means of a lower bearing consisting of a highly polished spherical-end steel point resting in a sapphire jewel. The upper bearing consists of a steel shaft centered in a sleeve steady-bearing made of sapphire. The entire moving system is carefully balanced and its light weight in conjunction with the highly polished bearing surfaces offers a moving system having practically negligible initial friction and one not easily damaged by the hard usage to which portable meters are frequently subjected.

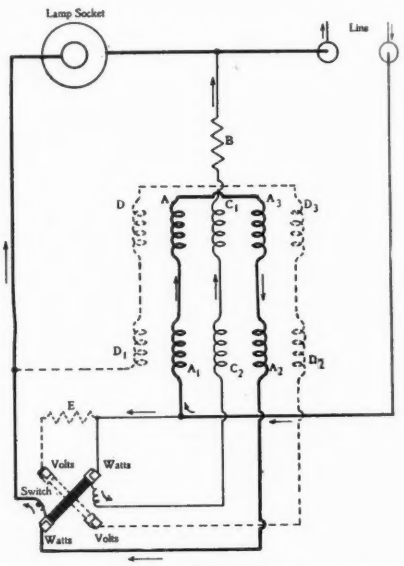


FIG. 4.—INTERNAL CONNECTIONS AND ARRANGEMENT OF COILS.

The lamp-testing volt-wattmeter operates upon the same principle as the standard voltmeter, differing only in arrangement of the measuring circuits. The meter is provided with a socket or receptacle for the introduction of the lamp to be tested and with a switch for cutting out the series windings alone. Connection is made by means of a pair of leads, the upper ends terminating in a plug to be screwed into the lamp socket of lighting circuit; the lower ends are provided with terminals for attaching to the binding posts.

When used in lighting installations, the lamp to be tested is removed from the line and inserted in the meter receptacle. The

meter is then connected to the socket from which the lamp was taken and a test is made under the conditions which exist in service.

Two concentric scales are provided, one indicating volts, and the other watts, and by use of the switch, the series winding can be cut in or out of circuit and the wattage of the lamp, or the voltage of circuit may be read. The meter may be used also as an ordinary voltmeter, or an ordinary wattmeter, without reference to its special lamp testing features.

Figs. 4 and 5 represent the internal connections and arrangements of the various coils in which A, A_1, A_2 and A_3 represent the wattmeter fixed coils and D, D_1, D_2 and D_3 represent the voltmeter fixed coils. Coils C_1 and C_2 represent movable

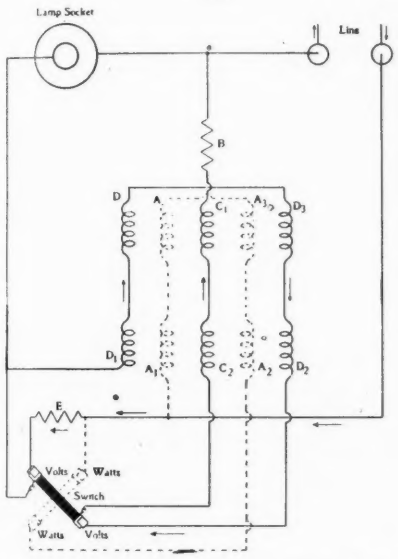


FIG. 5.—INTERNAL CONNECTIONS AND ARRANGEMENT OF COILS.

potential coils which are used with either the voltmeter or wattmeter arrangement. B represents the non-inductive series resistance connected in series with the moving element C_1, C_2, and E represents the compensating series resistance which is only used when the meter is connected for use as a voltmeter. Resistance E compensates for the drop in the series current coils.

In both sketches the full lines represent the coils and elements which are in circuit when the meter is being used for the purpose indicated on the drawing; the dotted lines showing the relative positions of the coils and elements which are not in circuit.

It will be noted that there are eight fixed coils, the outside group of four being of fine wire and for use when the meter is connected as a voltmeter, the inside group of four coils being of heavier wire, having one ampere capacity and used when meter is to be used as a wattmeter.

The switch consists of a simple insulating cross-bar carrying metal contacts at each end and so arranged as to engage the stationary contacts. The position of the switch indicates which combination of coils is being used.

An extremely valuable feature of the Kelvin construction is that the indications are unaffected by stray or external magnetic fields due to the employment of an astatically arranged measuring system, so connected that any stray field tendency to strengthen or weaken one element has the opposite effect on the other and thus eliminates error.

The meters are designed to give a "high torque" or turning moment, permitting the use of heavy control or restraining springs which, in conjunction with the light-moving elements and jeweled bearings, insure sensitive measuring elements which quickly and accurately respond to the slightest changes of load or pressure.

The construction adopted permits of extremely long scales (nine and one-fourth inches) and perfectly legible from one-fifth to full scale reading. This great scale length insures open clear divisions and enables reading to be taken with much greater accuracy than is possible with meters having short or congested scales.

In general it may be said that the meters are applicable to practically every condition arising in general practice where accurate measurements must be taken. It will be seen that in order to obtain a reading on this type of meter it is necessary to operate manually the indicating pointer, as contrasted with the direct-swing voltmeters on which the readings are immediately indicated without manual manipulation. For some classes of measurement when the pressure of system is of a rapidly fluctuating nature, the direct-swing type is preferable, owing to the fact that readings can be taken more rapidly than is possible with the zero-reading type. This one feature, however, is its only disadvantage if compared with the direct-swing type, and in all other features it is thought to be more satisfactory, owing to its inherently lower initial and life accuracy, lower torque, more fallible construction, susceptibility to error due to variations in frequency, wave-form, power-factor, effect of external magnetic fields, inability to maintain as high an initial accuracy under severe operating conditions, possibility of damage to pointer or movement through overloads and comparatively short scale.

APPLICATION OF ALLIS-CHALMERS VARIABLE-SPEED INDUCTION MOTORS TO THE MAKING OF MATCHES.

BY S. A. WOLFF.

A complete Allis-Chalmers power equipment consisting of two 300-kilowatt generators direct-connected to "Reliance" engines, a 110-kilowatt generator direct-connected to a high-speed engine, a five-panel switchboard, twenty-four five-horse-power, variable-speed induction motors and a number of constant-speed machines for distribution throughout the plant, was recently sold to the Diamond Match Company for its branch factory at Oshkosh, Wis., all of the apparatus being three-phase, sixty-cycle, 440 volts.

The unusual feature in connection with this installation is the fact that the match machines, which have always heretofore been group-driven, in this new plant will each be driven by a five-horse-power, 1,200 revolutions per minute Allis-Chalmers induction motor, twenty-four machines comprising the initial installation. It was shown by careful tests that individual drive in this plant will decrease the power consumption at least one horse-power per machine by eliminating the use of a mechanical speed changer as well as the long countershafts joining the groups of machines in the older installation.

In the process of forming the matches seventy-two sticks are made at each stroke by as many cutters. These sticks are then forced into countersunk holes of a plate conveyer from which they project at right angles, similar to the bristles of a brush. The motion of the conveyer is intermittent, depending on the speed of the machine, the travel being just sufficient to preserve a row of holes for each stroke of the cutters. While the sticks are in position in the conveyer they are in turn dipped in molten paraffine and a composition which forms the head. The matches must be dried before packing, and to accomplish this end the conveyer makes a number of loops exposing the matches to fans.

The test showed that 0.65 electric horse-power is required to drive the speed changer. The machine proper consumes 2.5, 2.7 and 3.4 electric horse-power at speeds corresponding to 160, 194 and 220 strokes of the cutters. Five horse-power motors were, therefore, chosen as being of the proper size for the work. It should be explained that speed reduction becomes necessary only during damp weather in order to allow the matches a longer interval in which to dry.

New Motor Rheostats.

The National Board of Fire Underwriters recently proposed a rule bearing directly on the vital part of a motor-starter, the resistance, which has aroused general interest. This rule stated that the resistance conductor should possess a low or negligible temperature coefficient. One of the arguments against the proposed rule was to the effect that resistance material of low temperature coefficient cost so much that motor-starting rheostats would have to be built with less material. This, it was stated, would require that the resistance material be embedded close to a heat-absorbing mass, and such construction would interfere with the rapid cooling of the resistance.

In the light of this discussion, the new motor-starting rheostats just placed on the market by the General Electric Company have special interest. These are shown in Fig. 1. This line of rheostats with no-voltage release, known as Type SA, and with no-voltage and overload release, Type SQ, is constructed with a new resistance unit, not only having a negligible temperature coefficient but also permitting a ventilated construction of the rheostat.

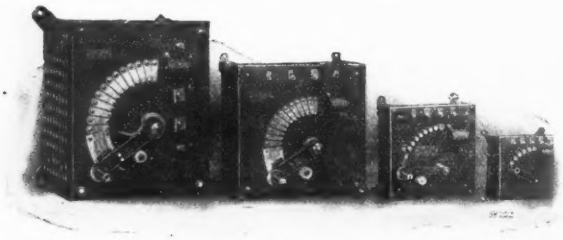


Fig. 1.—New Motor Starting Rheostats.

The new resistance, designated the form P unit, consists of a low temperature resistance material wound on a tube which is ventilated inside and out. The whole is covered on both surfaces with a special compound which effectively protects the wire and holds it in position. The unit so formed is fire and moisture proof, and, if accidentally raised to such a degree of heat as to melt the wire, will, it is said, open the circuit without appreciable arcing. The design of the form P unit, furthermore, increases the starting capacity of the rheostat from a duty of thirty seconds to a duty of one minute without increasing the dimensions.

In addition to these excellent electrical characteristics, the new unit permits many improvements in detailed mechanical construction. Because of the reduced space which the form P unit occupies not only is the space required per horse-power much less, but more room is available in which to make internal connections. This, together with the fact that all leads are insulated with glass beads, eliminates danger from grounds or short-circuits caused by crowded leads. The glass beads are excellent insulators and are also absolutely fireproof.

The form P resistance unit, as described, is used in rheostats of the following sizes: from one-eighth horse-power up to and including fifteen horse-power at 110 volts, from one-eighth horse-power up to and including thirty horse-power at 220 volts, and from one-eighth horse-power up to and including thirty-five horse-power at 550 volts. In rheostats of two horse-power and larger, the form P resistance units are fastened to supports independent of the iron cover, these supports being fastened to the slate top of the rheostats (See Fig. 2). This allows the resistance unit to be removed for inspection or repairs without disturbing other units or connections. In larger rheostats the iron grid type of resistance is used, the grids being treated with a compound which prevents rusting.

The arms of the dial switches are of rugged construction so as to undergo heavy handling without injuring the contact between the sliding brushes and the segments. The springs which pull the arms to the "off" position encircle the pivot stud and are positive in action. The arms may be easily removed from the rheostat by slippng out a cotter-pin.

In the smaller sizes, the sliding contacts consist of copper shoes held down firmly on the segments by springs. On motor rheostats above seven and one-half horse-power, 110 volts; ten horse-power, 220 volts; and fifteen horse-power, 550 volts, brass blocks are provided with carbon protecting blocks which precede the brass blocks while starting. This prevents pitting. The contact blocks, in all sizes, are self-aligning, and can be renewed readily without removing the switch-arm from the slate.

Care has also been taken with the stationary contact segments. The stationary contacts on smaller sizes are of brass, while on rheostats of larger sizes all the stationary contacts are made of copper and are renewable from the front. Rheostats in the larger sizes have the initial contact point protected by an auxiliary button which may be removed and renewed from the front.

The motor-shunt field-circuit is made and broken on the first live segment of the starting switch. When the starting arm passes to the "off" position the field is discharged through the motor armature and the starting resistance. This resistance, however, is not in series with the field in the "running" position.

All of the rheostats are fire and moisture proof and are built to withstand the hardest service. The general appearance of the rheostats is shown in the accompanying illustrations.

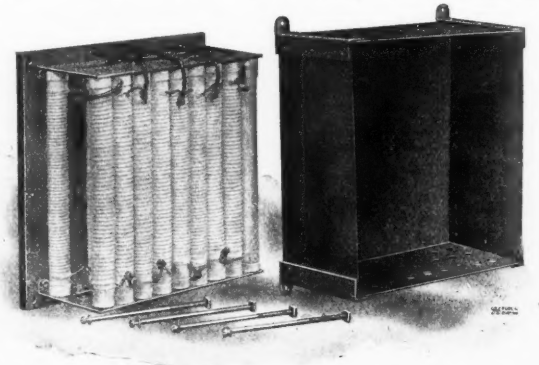


Fig. 2.—New Motor Starting Rheostat—Case Removed.

A New Company for the Manufacture of Concrete Poles.

A new company known as the American Concrete Pole Company, of Richmond, Ind., has been organized for the purpose of manufacturing reinforced concrete poles for electrical work. The present capital stock of the company is $10,000, which, it is said, will be increased as soon as the scope of the business has been ascertained. The objects of the company are to manufacture and sell reinforced or armored concrete cementitious telephone, telegraph, electric light, trolley, gas light and other poles and posts.

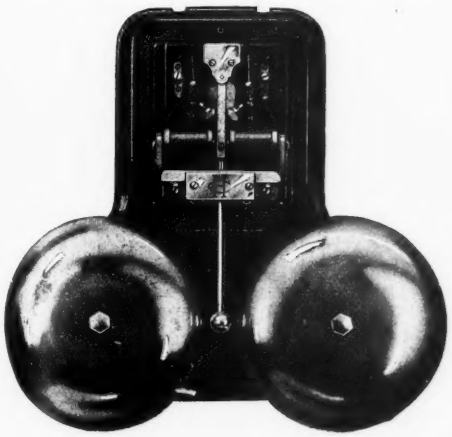
The officers of the company are: A. C. Lindemuth, president; William M. Bailey, vice-president and general manager, and Leroy E. Browne, secretary and treasurer. Mr. Lindemuth is president of the Richmond Home Telephone Company and also of the Indiana Independent Telephone Association. Mr. Bailey is the superintendent of the Richmond Home Telephone Company, and the inventor of the pole which is to be manufactured by the American Concrete Pole Company.

Stamped Steel Loud-Ringing Polarized Bell.

The accompanying illustration shows a new, loud-ringing polarized bell, which has just been developed and placed upon the market by the Holtzer-Cabot Electric Company, Brookline, Mass., and Chicago, Ill.

A distinctive feature about this bell is that the frame and case enclosing the mechanism are made from stamped steel, thoroughly japanned, which gives a rigidity to the bell and at the same time makes it much lighter in weight than the old cast-iron or wood-base types. Also, the stamped steel case is practically dust and moisture proof, thus enclosing the operating parts in a waterproof chamber, which is conductive to long life and highest efficiency.

The new bell is said to be particularly adapted for use on telephone lines as loud-



STAMPED STEEL BELL, COVER REMOVED.

ringing extension bells and on alternating-current power circuits of eighty to 220 volts, at frequencies of sixteen to sixty cycles. The current consumption of this bell, the manufacturer says, is extremely low, as has been proved by recent tests made by some of the largest telephone companies, and this is a feature much in its favor.

There are provisions in the base for a condenser, when required, and the coils may be wound for any desired resistance. The magnet spools are wound with silk-covered wire, well insulated, and the magnets and armature are of the highest grade of special iron. The terminal blocks are of solid hard rubber and all connections are so located as to be readily accessible. The gongs are first copper-plated before being heavily nickel-plated, thus insuring longer wear and preventing corrosion. Descriptive bulletins will be mailed to interested parties upon request, by the manufacturer.

Some DeVeau Telephone Specialties.

Some telephone specialties which are giving excellent service, and which are made by the DeVeau Telephone Manu-

FIG. 1.—BREAST TELEPHONE.

facturing Company, 27 Rose street, New York city, are shown in the accompanying illustrations.

Fig. 1 illustrates a variety of breast telephone apparatus used as a stenographer's

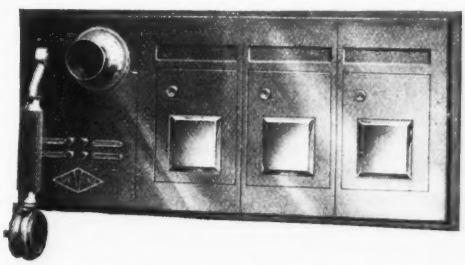


FIG. 2.—APARTMENT-HOUSE VESTIBULE TELEPHONE.

instrument. This same type is used in the United States Navy, worked by gunners, and from a position aloft enables the gun fire of the entire ship to be controlled by one man. The same arrangement may be enclosed in a diver's helmet, permitting him to communicate with his attendant. It is also found useful in many ways in offices.

Fig. 2 shows an apartment-house telephone intended for installation in vestibules. Any finish desired may be had. As will be seen, the instrument sets flush on the wall, no cord being used. The raising of the receiver cuts out the call-bell and cuts in the instrument battery.

A convenient desk type intercommunicating telephone is shown in Fig. 3. This is the company's patent automatic type, no central operator being required. It

FIG. 3.—DESK TYPE INTERCOMMUNICATING TELEPHONE.

brings all departments within speaking distance of one another at any time. Any finish desired can be furnished, and the instrument is constructed for any number of stations.

FIG. 4.—HAND MICROPHONE.

Fig. 4 shows a hand microphone intended to be used with the speaker in any position. This is a flush type of instrument having an outlet box in the wall, with no exposed wires. It is especially recommended for hospital use.

Current Electrical News

DOMESTIC AND EXPORT.

PROPOSED KENTUCKY LIGHTING MERGER—Efforts are being made to merge the Louisville Gas Company, the Louisville Heating Company, the Louisville Lighting Company and the Kentucky Electric Company. No information is available as to what form the merger will take, but probably a holding company will be organized with a capital stock of $15,000,000 to $20,000,000.

NEW POWER DAMS ON ST. JOSEPH RIVER—Representatives of Charles A. Chapin, of Chicago, have announced plans for the construction of three great power dams on the St. Joseph river, Mich., to cost $5,000,000. The company now has in operation or in course of construction on the river five power plants. The new properties will give it eight stations, with an aggregate investment of $10,000,000.

RAILWAY COMPANY FILES MORTGAGE—A mortgage for $2,750,000, given by the Toledo & Lima Traction Company, Toledo, Ohio, to the Provident Life and Trust Company, of Philadelphia, has been filed in the recorder's office at Ottawa. The mortgage was given to secure a bond issue to take up indebtedness and make improvements. The bonds are for $1,000 each and bear interest at the rate of five per cent.

NEW CALIFORNIA POWER ENTERPRISE—A waterfall on the Mokelumne river in central California is to be used by the General Electric Power Company, of California, for the development of electrical power. This fall will develop 69,000 electrical horsepower, which will be transmitted to all the towns and cities of central California, including the city of San Francisco. Contracts for the construction of the new power plant at a cost of nearly $10,000,000 have been let to the firm of Walston H. Brown & Brothers, of New York, who are now building the Belmont tunnel, connecting New York and Brooklyn.

UNITED RAILWAYS INVESTMENT COMPANY—At a meeting of the stockholders of the United Railways Investment Company the proposal of the directors to issue $3,000,000 three-year six per cent collateral trust notes was approved by the stockholders without opposition. Of these notes, $1,300,000 have been sold. The remaining $1,700,000, it is understood, will not be sold for the present. The proceeds of these $1,300,000 notes will be used for the acquisition of outstanding securities of the United Railroads, of San Francisco, Cal., and for other corporate purposes, including making provision for additional cars for use in that city.

BIG MORTGAGE RECORDED BY STREET RAILWAY COMPANY—A mortgage of $25,000,000 executed by the Birmingham (Ala.) Railway, Light and Power Company to the Old Colony Trust Company, has been recorded in the probate office. The instrument recites the sale and conveyance of all real and personal property, franchises, etc., of the local street railway company. The mortgage was executed to protect the issuance of the $25,000,000 of bonds recently authorized by the directors of the Birmingham Railway, Light and Power Company. Outstanding bonds will be retired and extensive improvements made by the company.

ELECTRIC COMPANIES MERGE—A merger has been placed on record with the recorder of Elkhart county, Ind., whereby the Indiana & Michigan Electric Company has absorbed the St. Joseph & Elkhart Power Company, capital $250,000; the Elkhart Electric Company, capital $150,000, and the South Bend Electric Company, capital $150,000. The new organization will retain the name of the Indiana & Michigan Electric Company, and will have a capital stock of $1,915,500. The life of the concern is fifty years, and the headquarters will be in South Bend. The company will furnish light and power in Berrien, Cass, St. Joseph and Van Buren counties, Mich., and in Elkhart, St. Joseph and Laporte counties, Ind. The directors are: Charles A. Chapin, Henry K. Chapin, Homer C. Chapin, Harden D. Crawford, Fred L. Dennis, Charles B. Calvert, Marshall L. Howell, Fred A Bigam and Richmond Talbott.

NEVADA-CALIFORNIA POWER COMPANY—The Nevada-California Power Company is building a large reservoir near the summit of the Sierra Nevada Mountains, 100 miles from Goldfield, Nev., in which to store 300,000,000 gallons of water. This will provide the power for the generation of electricity to run the machinery in the mills and mines and to light the desert towns. The power plants are located about twelve miles below the reservoir and from them the power will be distributed to Bullfrog, Goldfield, Silver Peak, Tonopah, Miller's Station and Manhattan. The present power plant has a daily capacity of 600 horse-power. The new plant will have 16,000 horse-power capacity. A third and smaller plant is also being constructed about three miles below plant No. 1, with 4,000 horse-power capacity. It is estimated that by the first of September, the entire distributing system, together with the generating plants and the storage reservoir, will be in commission. The company is expending $3,000,000.

TELEPHONE COMPANY CHANGES HANDS—Five hundred thousand dollars has been paid by the American Union Telephone Company, Pittsburg, Pa., for the Tristate Telephone Company, operating in Fayette and other counties in western Pennsylvania. This deal insures long-distance business with New York, Philadelphia, Baltimore, Pittsburg, Cleveland, Chicago and intermediate places. The American Union has recently absorbed a number of independent systems and now has connections between Syracuse, Elmira and Philadelphia, New York in the East and Baltimore in the South. The Union Telephone Company, of Erie, gives connection with New Castle and towns west between Cleveland and Chicago. The Bedford County Telephone Company, a recent acquisition, completes the chain between Pittsburg and the East. Within a few months it is expected the service will be working. In Pittsburg and vicinity the Pittsburg & Allegheny Telephone Company gives connection with a large number of cities and towns.

NEW WASHINGTON ELECTRIC PROJECT—W. R. Rust, president and general manager of the Tacoma (Wash.) Smelting Company, is at the head of a million-dollar corporation that will build an electric railway in eastern Washington. Construction will begin next winter between Kennewick and the new town of Hanford. It is the intention to extend the railway beyond Wenatchee, on the Great Northern, making the road about 135 miles in length. Electricity will be furnished by a 40,000-horse-power plant at Priest Rapids. Articles of incorporation of the Priest Rapids Railway Company have been filed. The articles declare the plan to be to build a railroad in Douglas county and from Wenatchee in the county of Chelan, thence in a southerly and southeasterly direction through the counties of Chelan, Kittitas, Yakima and Benton to some point on the line of the Northern Pacific Railway. The Priest Rapids Railway Company is allied with the Hanford Irrigation Company. Hanford is northeast of North Yakima. W. R. Rust, of Tacoma, is president of the electric railway company; H. K. Owens is chief engineer; M. B. Haynes is treasurer, and E. H. Guie is secretary.

PENNSYLVANIA TROLLEY DEAL—The West Penn Railways Company has acquired a controlling interest in the Pittsburg, McKeesport & Greensburg Railway Company. The effect is to give the West Penn a system extending from Masontown, Fayette county, Pa., through the principal towns in Westmoreland county to Trafford City, Allegheny county, and a direct connection at the latter point with the Pittsburg Railways Company system. Negotiations had been in progress for several weeks. At a meeting held in Greensburg, Pa., July 22, the board of the Greensburg company was reorganized, all the directors retiring with the exception of Lloyd B. Huff and Richard L. Coulter, Jr. Separate organizations will be maintained. The new board of directors and officers of the Pittsburg, McKeesport & Greensburg Railways Company are: Lloyd B. Huff, president; Richard L. Coulter, Jr.; J. H. Purdy, vice-president; J. B. Van Wagener, treasurer; H. I. Lynne and Byron Trimble. The last four named are new di-

rectors representing the West Penn Railways Company. The addition of the twenty-eight miles of the Greensburg company gives the West Penn Railways Company a total mileage of 154 miles, and makes it the largest interurban traction system in the state. The combined capitalization is $13,055,000. The total deal involves the joint ownership of all the charters acquired by both companies between Greensburg and Latrobe. It is said the line between these two cities will soon be built. The West Penn Railways also furnishes electric light and power to nearly two score towns and cities in the territory, including Masontown, Uniontown, Connellsville, Dawson, Scottdale, Everson, Youngwood, Greensburg, Jeannette, Manor and Irwin. The gross earnings for the fiscal year ended June 30 last approximated $1,500,000. The officers of the West Penn Railways Company are: chairman of the board, E. C. Converse; president, W. S. Kuhn; vice-president, J. S. Kuhn; secretary, R. P. Watt, and treasurer, J. B. Van Wagener.

NEW INCORPORATIONS.

LANSING, MICH.—Murphy Power Company, Detroit. Capital increased from $750,000 to $2,000,000.

SEATTLE, WASH.—Bard Electric Company. $250,000. Incorporators: W. H. Bard and Charles D. Haskins.

INDIANAPOLIS, IND.—Aurora Electric Company, Aurora. $15,000. Directors: Charles F. Mayer, Henry B. Spaeth and David J. Hause.

BURLEY, IDA.—Milner & North Side Electric Railway Company. $250,000. Incorporators: Fentress Hill, D. C. MacWatters, Herbert R. Grant, Henry K. Belmont and C. M. Hapgood.

ALBANY, N. Y.—The American Electrical Development Company, of Amsterdam. $100,000. Directors: R. T. Ford, of Rochester; T. J. Murphy, of New York, and Richard Murphy, of Amsterdam.

SALT LAKE CITY, UTAH—The Uintah Telephone Company, of Vernal. The company will operate a telephone system in Uintah county. $10,000, divided into shares of the par value of $10 each. W. H. Smart, president; C. S. Carter, vice-president; R. S. Collett, secretary; J. K. Bullock, treasurer.

COLUMBUS, OHIO—Elyria Southern Railway Company. To construct and operate a line between Elyria and West Salem, Ohio, through the counties of Lorain, Medina, Wayne, Ashland, Richland and Knox. $100,000. Incorporators: W. E. Elliot, F. W. Carpenter, W. E. Moses, J. M. Starr and F. L. Sargent.

NASHVILLE, TENN.—Clarksdale, Collierville & Covington Interurban Company, Shelby county. This company proposes to construct a street and interurban railroad in Memphis and Shelby and adjacent counties. $50,000. Incorporators: R. F. Tate, C. F. Farnsworth, A. Walsh, W. A. Gage, W. E. Willett, H. E. Craft and others.

PORTLAND, ME.—Portland, Gray & Lewiston Railroad Company. To run through the towns of Falmouth, Gray and New Gloucester and thence to Auburn and Lewiston. $150,000. Shareholders: Edward W. Gross, of Auburn; Charles C. Benson, of Lewiston; Lewis A. Goudy, of Portland; John D. Clifford, of Lewiston; William M. Sturgis, of Scranton, Pa.; N. D. Sturgis, of Scranton, Pa.; Tracey W. Holland, of Brooklyn, N. Y.

SPRINGFIELD, ILL.—Madison County Interurban Belt Railway Company, Highland. To be constructed from Stanton, Macoupin county, south of Williamson, Madison county, thence east to New Douglas, thence south to Grand Fork, thence south to Highland, thence west to St. Jacob's, thence southwesterly to Troy, thence west to Collinsville, Madison county. $25,000. Incorporators and first board of directors: W. P. Wall, John Bardilla, John Gehrig, John Wildi and J. L. Rhein.

NEW PUBLICATION.

NATIONAL ELECTRICAL CODE—The new edition of the National Electrical Code for 1907 has been issued as revised. This gives all the changes that have been made in the code, and contains a list of fittings, materials, etc., revised down to date. Copies may be obtained from C. M. Goddard, secretary of the Underwriters' National Electrical Association, 55 Kilby street, Boston, Mass.

TELEPHONE AND TELEGRAPH.

BATH, ME.—The New England Telephone and Telegraph Company has completed a new line between this city and Brunswick.

HARRISBURG, PA.—The Bell Telephone Company has certified to an increase in its capital stock from $24,950,000 to $25,972,000.

EAST PROVIDENCE, R. I.—The Providence Telephone Company is making arrangements to change the local system to a common battery system.

READING, MASS.—The New England Telephone and Telegraph Company has placed in operation its new exchange at Reading. The ultimate capacity is to be 1,600 stations.

QUINCY, CAL.—The Forestry Service is to construct a telephone line from this city to Prattville, with branch lines from that place to Humbug Valley. Other branch lines will be built next summer.

LOS ANGELES, CAL.—A decision given by Judge Olin Wellborn, of the United States Circuit Court, in the case of Los Angeles against the Home Telephone and Telegraph Company, holds that the city has the legal right to fix gas, telephone and electric light rates.

PHILADELPHIA, PA.—The contract for the installation of a private switchboard and ninety-five telephones in the Philadelphia Hospital, has been awarded to the Bell Telephone Company. The hospital is entitled to 30,000 calls and the service is to cost $1,386 for the year.

BERKELEY, CAL.—The Home Telephone Company has purchased the southwest corner of Milvia street and Allston way, ninety feet by ninety feet, as a site for a new office and exchange building to be used by the corporation. The structure is to cost about $60,000.

NOME, ALASKA—Local representatives of the Seattle-Alaska Wireless Telegraph Company are planning to buy forty acres of land for the construction of a sixty-horse-power station at Dutch Harbor and Grays Harbor. Negotiations have been opened and the deal is to be closed in the near future.

NEW ALBANY, IND.—Arrangements are being made by the Eureka Telephone Company, of Harrison county, to establish an exchange in Corydon, which will be connected with the Home Telephone Company, of this city. The Eureka has lines in nearly every part of Harrison county, connecting with over 800 farmhouses.

SISSON, CAL.—The forest service telephone line has been completed between Sisson and Trinity Center. The line was built primarily as a part of a fire-alarm system, though it can be used for the transaction of other forest-service business. From Sisson to Trinity Center it is forty-five miles by wire. Branch lines add fifteen miles to the length. The branches connect with the summer signal station on Mount Eddy and Bonanza King mountain and with the ranger's station at Callahan.

NORWICH, N. Y.—J. B. Marquis, of Norwich, owner of the Marquis Independent Telephone lines, is completing arrangements to connect his lines with the Earlville (Newton) independent company. The Marquis line will closely follow the line of the Lackawanna tracks. Rights of way have been secured and laborers are already at work setting poles. This will give the local Marquis exchange direct wires to practically the whole of Madison county. The Newton company, with which the Marquis lines will connect at Earlville, has a large mileage of telephone lines throughout Madison and part of Oneida counties.

NEW MANUFACTURING COMPANIES.

SPOKANE, WASH.—R. Doerr, J. R. Mitchell and R. C. Steeple have incorporated the Doerr-Mitchell Electric Company, with a capital of $100,000. They have been doing an electrical business in Spokane for some years.

AUGUSTA, ME.—The Linolite Company of America, Portland, has been incorporated with a capital of $300,000, to manufacture electric lamps and fixtures. The president is William M. Sturgis, Scranton, Pa., and the treasurer, R. W. Philips, of New York.

ELECTRIC RAILWAYS.

HILLSBORO, ORE.—The city council has granted franchises to the United Railway Company and the Oregon Electric Company.

BLOOMINGTON, ILL.—The Illinois Traction System has placed in operation its new power-house at Peoria. This plant has a capacity of 5,400 horse-power.

ALBANY, N. Y.—The Rochester, Stottsville & Caledonia Electric Railroad Company has certified to the secretary of state that it has increased its capital stock from $500,000 to $2,500,000.

UNION, S. C.—The South Carolina Public Service Corporation, which proposes building an electric railway from Charleston to all the towns in the Piedmont section, has been granted a perpetual franchise by the city council of Union.

SPRINGFIELD, MASS.—The new electric railway line between this city and Worcester, has been opened. For the present cars will be run on the hour from each terminal, and are expected to cover the distance in two and one-half hours.

PITTSFIELD, MASS.—The Bennington & North Adams Street Railway Company has given a mortgage of $450,000 to the Union Trust Company, of Springfield. The money will be used in building extensions and other improvements to the road.

WILKES-BARRE, PA.—The Northern Electric Street Railway Company has opened its line from Scranton to Dalton. The road will be extended from Dalton to Factoryville and a spur will also be built from La Plume over the mountain to Lake Winola.

BRUNSWICK, GA.—The city council has given a street railway franchise to F. D. M. Strachan and associates, with the provision that work on the construction of the line is to commence within six months, and five miles of railway is to be completed within a year.

LANSING, MICH.—Included in the announcement that Theron W. Atwood, counsel for the Michigan United Railways, has been elected president of the Northern Construction Company, an allied corporation, is a statement that the Lansing & Jackson trolley line will be built this year, provided satisfactory franchise arrangements can be made in Mason.

ANNAPOLIS, MD.—The Annapolis city council has passed the trolley franchise ordinance in form amended from that adopted June 21. The promoters of the Washington, Baltimore & Annapolis Electric Railway Company immediately accepted the franchise and gave the necessary bonds.

OKLAHOMA CITY, OKLA.—General Manager John W. Shartel, of the Oklahoma City Street Railway, has announced the contemplated erection of a $175,000 power-house in this city to supply the power for the Oklahoma City and Guthrie lines and seventy-five miles of interurban street railway.

UTICA, N. Y.—The Utica & Mohawk Valley Railway Company has filed with the secretary of state a certificate of merger of the Rome City Street Railway. This means that the Rome City Street Railway, which for several years has been owned by the Vanderbilt-Andrews syndicate, is formally consolidated with the Utica & Mohawk Valley Railway system.

BUCYRUS, OHIO—Grading has been resumed on the Bucyrus-Marion electric line. The work was suspended late last fall when winter set in. It is understood the line will be completed and put in operation this fall. It will be eighteen miles long and connect at Marion with the Webb line into Columbus and at Bucyrus with the Cleveland, Southwestern & Columbus for Cleveland.

LIMA, OHIO—The Schoepf syndicate, operating the city lines and with a half dozen interurbans out of Lima, is making a bid for an extension of street franchises, and petitions are being circulated offering for the granting of new franchises for twenty-five years the building of a central interurban passenger station in the public square to cost $50,000. The present franchise expires in 1917, and a renewal is desired for bonding purposes.

SULLIVAN, IND.—The board of commissioners of this county has granted a franchise to the Terre Haute & Merom Traction Company. The proposed road passes through Fairbanks, Staffordshire, Graysville, Merom and Merom Junction. The franchise provides that the work on the same shall be commenced by February, 1908, or the franchise will be forfeited. President O. L. Brown states that the company has secured two-thirds of the right of way, and that the work will be commenced this fall if possible. The company proposes to have cars in operation one year after the construction is begun.

WEST NEWTON, PA.—The town has sold the municipal electric light plant to the Pittsburg, McKeesport & Westmoreland Street Railway Company, which intends to operate the plant to furnish light to the town and also to enlarge it sufficiently to provide power for trolley cars when the traction line is built here from Irwin. Work on the local end of the road is expected to soon begin. West Newton began to operate its light plant in 1903, but the service is said not only to have been unsatisfactory, but too expensive as well.

UTICA, N. Y.—It has been announced by G. Loomis Allen, general manager of the Utica & Mohawk Valley Railway and the other trolley systems in central New York, that the Andrews-Vanderbilt syndicate, of which he is a representative, will build a trolley road from Rome to Oneida. Franchises have already been secured and plans made for the route. General Manager Allen said that the road would be started as soon as the state of the money market would permit. It is expected that the line will follow the route laid out by the old Rome & Oneida Railway Company.

BALTIMORE, MD.—The Baltimore, Halethorpe & Elkridge Electric Railway Company has secured the right of way for the new railway from Baltimore to Halethorpe. It is the desire of the promoters that the work of grading and laying the tracks begin this fall. Owing to the present financial condition, difficulty has been encountered in financing the project, and it is probable that for this reason work on the new road will not begin until next spring. It is the intention of the company at first to operate only as far as Halethorpe, and later extend the line to Elkridge.

WINCHESTER, VA.—Plans are now under consideration by the Winchester & Washington City Railway Company for the construction of an electric railway between this place and Washington by way of Bluemont. The following is a list of the directors of the company who were reelected officers: president, S. H. Hansbrough, Winchester; vice-president, Charles Milliken, Clarke county; secretary and treasurer, Shirley Carter, Winchester; general manager, S. L. Hoover, Winchester; executive committee, S. H. Hansbrough, Charles Milliken and Lewis Cooper, of Winchester; superintendent, D. M. Swink. H. C. Warden has been elected a director.

MILWAUKEE, WIS.—The Chicago & Milwaukee electric road is said to have completed its arrangements for entrance to Chicago. The city council has passed the ordinance permitting the electrification of the Milwaukee steam road tracks from Wilson avenue to Evanston. At Wilson avenue the interurban road will take to the elevated structure of the Northwestern elevated road, and continue down-town to the union loop. The interurban road now terminates at the Milwaukee road station in Evanston. For a distance of two miles north of Evanston the tracks of the steam road are used. From the Evanston station to Wilson avenue is six miles, and from there to the centre of Chicago another six miles. It is expected that the interurban road will proceed as speedily as possible with the electrification of the steam road's tracks. By early fall it is probable that the road will be able to give through service between Chicago and Milwaukee.

ALBANY, N. Y.—The franchise and all obligations of the Troy & New England Railroad have been turned over by Edward F. Murray, acting under an order of the court, to the Delaware & Hudson Railroad Company. By that act Mr. Murray ceased to be receiver for the company, and by subsequent action he and all the old directors of the company placed their resignations in the hands of the new owners, Mr. Murray also retiring from the presidency. The resignations accepted were those of Uri Mallery, William P. Dalton, James Farrell, James W. Donnelly, David B. Plum and John W. Jones, and in their places L. F. Loree, C. S. Sims, Axel Ekstrom, Edgar S. Fassett, C. E. McKim and Thomas B. Dixey were elected. L. F. Loree was subsequently chosen president of the Troy & New England, C. S. Sims, vice-president, and James McCredie, treasurer, in place of Rice C. Bull, who resigned. President Loree, Vice-President Sims, Edgar S. Fassett, Edward F. Murray, Thomas B. Dixey, Axel Ekstrom and C. E. McKim were appointed an executive committee, and the following old directors were retained for the present: Edward F. Murray, Rice C. Bull, C. W. Tillinghast, David Morey, Owen A. Mullen and William D. Mahony.

PERSONAL MENTION.

MR. GEORGE E. STEBBINS has resigned as manager of the Chicopee, Mass., electric light plant.

MR. WILLIAM R. WESTCOTT, manager of the Manchester (N. H.) office of the New England Telephone and Telegraph Company, has resigned.

MR. F. G. BOLLES, who for many years was an active member of the electrical industry, has recently returned to America, after a stay of ten months in the large cities of Germany and the Continent.

MR. JOHN B. PULLIAN, of Fruitport, Mich., has been made general manager of the Winnebago Traction Company, Oshkosh, Wis., to succeed Edward B. Kirk. The company was recently placed in the hands of a receiver. Extensive improvements will be made.

MR. LOUIS GLASS, who was charged with bribing supervisors in the interest of the Pacific States Telephone Company, has been released upon a disagreement of the jury. This case was in connection with the recent trials which have been held in San Francisco with regard to the alleged illegitimate disposition of franchise privileges.

MR. JOHN Z. MURPHY, the Chicago Union Traction Company's chief engineer, has been appointed to represent the company and its allied interests on the board of supervising engineers. Mr. Murphy has been chief engineer of the North and West Side lines for several years. His appointment, it is said, will be subject to the approval of the Chicago Railways Company.

MR. L. H. CONKLIN has been advanced from the position of superintendent of lighting of the West Penn Electric Company, Pittsburg, Pa., to that of general superintendent of both the West Penn Railways Company and the West Penn Electric Company. Mr. Conklin has been connected with the West Penn Electric Company since March 15, with headquarters at Connellsville, Pa.

PROFESSOR WILLIAM FREEMAN MYRICK GOSS, professor of experimental engineering and dean of the engineering laboratory of Purdue University since 1890, has been elected dean of the engineering college at the University of Illinois. Professor Goss has accepted the position, to take effect September 1. Dr. Goss was a student at the Massachusetts Institute of Technology, when he was called twenty-seven years ago to organize the department of practical mechanics at Purdue, one of the first of these departments organized in the country. He is recognized as an authority on railway engineering and upon the scientific and practical aspects of the steam engine. Professor Goss also will be appointed director of the new school of railway engineering and administration recently organized at the University of Illinois. The effort of the university is to organize in a larger and more satisfactory way than ever before a comprehensive scheme of training for railway service, not only in the department of railway engineering, but in the department of organization and operation as well.

OBITUARY NOTE.

MR. SAMUEL McCLINTOCK HAMILL died on Monday, July 29th, at his home in Schenectady, N. Y., of typhoid fever. Mr. Hamill was born at Lawrenceville, N. J., March 27, 1858. He was graduated from Princeton University in 1880. On November 27, 1900, he married Maria Woodward Baldwin. Mr. Hamill was very well known in the electrical field. In 1886, he became manager of the Brush Electric Company, of Cleveland, Ohio, which was afterward consolidated with the General Electric Company, with which Mr. Hamill was closely connected at the time of his death. He was president of the Schenectady Trust Company, a member of the Schenectady Club, University, Ivy, Golf, Nassau and Trenton Country Clubs.

ELECTRICAL SECURITIES.

Last week's stock markets showed a little more activity than usual, and although price movements were irregular, there may be noticed some good gains in certain lines. This is evidently by reason of clever handling and a systematic uplifting of specific issues which once up have stayed up. Where there was any unloading there was a demand which absorbed the offers so readily that any general disposal of stock was soon checked. The railroads continue to show record earnings, but there is a tendency to go easy in making new investments and probably there will be some curtailing of expenses. In general, however, business continues good, with lessened apprehension regarding widespread contraction. It is expected that steel operation for the second quarter will prove to be enormous, with unfilled orders aggregating 7,500,000 tons of finished material. Altogether, the wane of the summer is very satisfactory and indications are greatly improved over those of a month ago.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JULY 27.

New York:	*Closing.*
Allis-Chalmers common	9⅞
Allis-Chalmers preferred	27
Brooklyn Rapid Transit	59⅛
Consolidated Gas	121⅞
General Electric	139
Interborough-Metropolitan common	16¼
Interborough-Metropolitan preferred	45
Kings County Electric	118
Mackay Companies (Postal Telegraph and Cables) common	69⅛
Mackay Companies (Postal Telegraph and Cables) preferred	68
Manhattan Elevated	132
Metropolitan Street Railway	85
New York & New Jersey Telephone	110
Western Union	78
Westinghouse Manufacturing Company	145

The annual meeting of the stockholders of the Westinghouse Electric and Manufacturing Company was held in Pittsburg, Pa., July 24. The old board of directors was reelected with the exception that W. McConway was elected to fill the vacancy caused by the death of P. F. Topping. The statement of the Westinghouse Electric and Manufacturing Company for the three months ended June 30, 1907, the first quarter of the current fiscal year, shows a vast improvement in earnings over the corresponding period of last year. The total income of the company for the three months was $1,943,096, which was at the rate of $7,772,384 a year. The total income in the last fiscal year was $5,435,910, so that earnings in the first quarter of the current fiscal year ran at the rate of $2,336,474, or forty-two per cent in excess of the actual earnings of the preceding year. After deducting $870,214 in connection with interest on bonds and debenture certificates, miscellaneous interests, depreciation, etc., there remains a net credit to surplus of $1,072,882, which is at the rate of $4,291,528 a year.

Boston:	*Closing.*
American Telephone and Telegraph	107
Edison Electric Illuminating	211½
Massachusetts Electric	55
New England Telephone	109
Western Telephone and Telegraph preferred	65

Directors of the New England Telephone and Telegraph Company have declared the regular quarterly dividend of 1½ per cent, payable August 15 to stock of record July 31.

Philadelphia:	*Closing.*
Electric Company of America	9⅞
Electric Storage Battery common	51
Electric Storage Battery preferred	51
Philadelphia Electric	8⅜
Philadelphia Rapid Transit	22
United Gas Improvement	91

It is understood that the gross earnings of the Philadelphia Rapid Transit Company for the fiscal year ended June 30, increased about $600,000 over the preceding year. It is expected that the net earnings will not be materially larger than last year, because of high operating costs and liberal sums spent for improvements, renewals, etc.

Chicago:	*Closing.*
Chicago Telephone	115
Chicago Edison Light	144
Metropolitan Elevated preferred	64¼
National Carbon common	72½
National Carbon preferred	117
Union Traction common	—
Union Traction preferred	—

Directors of the National Carbon Company have declared the regular quarterly dividend of 1¾ per cent, on the preferred stock payable August 15. Books close August 5, and reopen August 16.

The $5,000,000 5 per cent three-year notes of the Chicago Edison Company have been entered in the unlisted department of the Chicago stock exchange.

The city council has adopted a flat business rate for the Chicago Telephone Company, as a result of the objections to a measured service.

ELECTRIC LIGHTING.

STANTON, NEB.—The city has voted to take over the electric plant and operate it.

WENATCHEE, WASH.—Work has been started on the new electric power plant to be built by the Wenatchee Electric Company.

OROVILLE, CAL.—A 255-horse-power dynamo has been added to the electrical equipment of the Oro Light and Power Company's plant.

MOUNT AYR, IOWA—A contract has been entered into by the city council and A. Bartenlanger, of Omaha, to construct an electric light plant at a cost of $17,626.

CARROLLTON, MISS.—The plant of the Carrollton Electric Light and Power Company was destroyed by fire on July 19. The loss was $10,000, partly covered by insurance.

NEW HAMPTON, IOWA—The contract for the new power plant for the light and water plants owned by the city has been let to home bidders, Shepard & Hutton, their bid being $8,611.

TOLEDO, OHIO—The Central Heating and Lighting Company has decided to more than double the capacity of its plant. The increase is made necessary by a large growth in business.

WILLOWS, CAL.—A franchise has been awarded the Snow Mountain Power Company by the Glenn county board of supervisors to erect lines and transmit power throughout the county.

NAPA, CAL.—The board of supervisors has granted D. L. Beard a franchise to maintain and erect poles and wires over the roads of this county for the transmission of electric light and power.

MORETOWN, VT.—The Moody & Almon electric plant will extend its lines to this place from the power plant near Middlesex village, and will light the streets, stores and houses. The line will be extended later to Waitsfield.

TURNERS FALLS, MASS.—At the annual meeting of the Franklin Electric Light Company, the following officers were elected: J. F. Bartlett, president; E. I. Cassidy, clerk; W. C. D. Thomas, treasurer. Directors: J. F. Bartlett, E. I. Cassidy, C. W. Schuler, C. W. Hazelton, Porter Farwell.

HATTIESBURG, MISS.—The Hattiesburg Light and Power Company, the Hattiesburg Traction Company, and the Hattiesburg Gas Company have been merged into one company, and the new corporation will retain the name of the Hattiesburg Traction Company. The combined capital is $300,000. This will be increased at once to $500,000.

BRATTLEBORO, VT.—The Connecticut River Dam and Power Company, organized in New Hampshire, and also in Vermont, has recorded at Keene, N. H., a mortgage of $2,000,000 in favor of the Old Colony Trust Company, of Boston, to secure five per cent bonds which the company will issue. Work on the plant, at Hinsdale, N. H., is now in progress.

ASBURY PARK, N. J.—The council has passed the ordinance granting to Moore & Clarkson a franchise to construct and operate an electric power plant in this city. The vote was taken subject to the men named depositing with the city clerk a personal bond in the sum of $10,000 before the ordinance should be approved by the mayor. Following that a surety bond will be given.

INDIANAPOLIS, IND.—The county commissioners have granted the petition of the Indianapolis Light and Heat Company for a franchise to erect a pole line between Brightwood and Fort Benjamin Harrison for the purpose of supplying the post with light and power. The pole line will extend out of Brightwood along the Pendleton pike to the first road east of Lawrence and will then run north to the army post.

GARDNER, MASS.—At the annual meeting of the Gardner Electric Light Company, the following officers were elected for the ensuing year: president, Arthur P. Derby; vice-president, Thatcher B. Dunn; secretary and treasurer, Francis S. Whittemore. Directors: Arthur P. Derby, Thatcher B. Dunn, Francis S. Whittemore, Charles W. Conant, Charles O. Bent, Charles F. Richardson, William D. Smith, Helen R. Greenwood and Martha Heywood.

ORANGE CITY, IOWA—The stockholders of the Orange City Electric Light Company have decided to rebuild the plant which was destroyed by fire a few weeks ago. The new building will be forty feet wide and fifty feet long. It will be built of concrete and cement and made as nearly fireproof as possible. A duplicate set of machinery will be installed. Work will begin at once, and the company hopes to have things in running order within two months.

PITTSBURG, PA.—The East Pittsburg borough council has awarded a contract for street lighting in the borough to the Rose Hill Electric Light Company, of Turtle creek, to run for five years. The contract price is the lowest ever offered to any municipality in the western part of the state, $55 per arc light per year. The Monongahela Light and Power Company, a subsidiary concern of the Philadelphia Company, has had the contract for furnishing light to East Pittsburg during the past thirteen years.

DAVENPORT, IOWA—Amendments to the articles of incorporation of the Davenport Gas and Electric Company have been filed with the county recorder reducing the capital stock from $800,000 to $25,000. The amendments state that the capital stock shall be reduced to the amount stated above by retiring sufficient shares of stock and paying the stockholders for the same. Members of the company state that the Davenport company will continue in business for the sole purpose of running the steam heating plant connected with its system.

MILWAUKEE, WIS.—Three leading commercial organizations, the Merchants & Manufacturers' Association, the Greater Milwaukee Association and the Milwaukee Real Estate Board, have joined in an appeal to the citizens to abandon the municipal electric lighting project. At a special election some time ago the city voted a $500,000 bond issue. The cost now would run up to $2,000,000. The reason urged is that Wisconsin now has a public utilities commission which can make equitable rates, and that Milwaukee needs its money for schools and parks.

ROCHESTER, N. Y.—The Rochester Railway and Light Company is building a transformer substation at the southeast corner of the crossing of Elmwood avenue and the Lehigh Valley Railroad, at which the current to be supplied by the Niagara, Lockport & Ontario Power Company will be delivered and stepped down to a voltage suitable for transmission on the city cables and wires. The building will be completed about September 1, and the last of the machinery will be installed, it is expected, some time in October. The substation will have a frontage on Elmwood avenue of fifty feet, ten inches, and a depth of 118 feet. It will be built of reinforced concrete, and will be practically fireproof.

LEGAL NOTE.

EICKEMEYER PATENT LITIGATION—In the United States Circuit Court for the Northern District of New York, Judge Ray handed down an opinion in the case of the General Electric Company *vs.* Wilbur F. Corliss *et al.*, trading under the name of Corliss, Coon & Company, upon Eickemeyer patent No. 677,308, granted June 25, 1901. This suit was brought by the General Electric Company to restrain Corliss, Coon & Company, of Cohoes, N. Y., from further infringement of Eickemeyer patent No. 677,308 in the use of some induction motors manufactured by the Allis-Chalmers Company. The feature of these motors which formed the basis of the suit was the relation between the number of slots in the field and the number of slots in the armature whereby all dead points or locking positions are eliminated from the motor. This feature is believed to be essential to all commercial induction motors of any size. The court holds that the patent is valid and infringed by the defendants.

DATES AHEAD.

Jamestown Tercentennial Exposition. Norfolk, Va., April 26 to November 30.

International Association of Municipal Electricians. Norfolk, Va., August 7-9.

Ohio Electric Light Association. Annual meeting, Toledo, Ohio, August 20-22.

Michigan State Electrical Association. Battle Creek, Mich., August 20-22.

Canadian Electrical Exhibition. Montreal, Quebec, September 2-14.

Canadian Electrical Association. Annual convention, Montreal, Quebec, September 11-13.

Colorado Light, Power and Railway Association. Annual convention, Denver, Col., September 18-20.

Railway Signal Association. Annual meeting, Milwaukee, Wis., October 8-10.

INDUSTRIAL ITEMS.

THE AMERICAN CONDUIT COMPANY, New York, N. Y., Chicago, Ill., and Los Angeles, Cal., announces that the Jamestown Exposition authorities have used approximately 200,000 feet of its three-inch bituminized fibre conduit and that this has proved entirely satisfactory.

EUGENE MUNSELL & COMPANY AND THE MICA INSULATOR COMPANY, on or about September 1, will move from 218 Water street, New York city, to their new offices, at the southwest corner of Vesey and Church streets (No. 33 Vesey street), where they will occupy four floors.

THE SPRAGUE ELECTRIC COMPANY, New York city, has issued a forty-four-page instruction book, which treats in detail of the proper installation of Greenfield flexible steel conduit and flexible steel-armored conductors. This book is handsomely gotten up in convenient pocket size and will be found of value by the man who installs the wiring in public or private buildings, cars or steamships.

V. C. GILPIN, 120 Liberty street, manufacturer's agent, distributed a most unique advertising folder at the recent electrical contractors' convention, with the picture of V. C. Gilpin, Jr., six months old. Mr. Gilpin now represents the following manufacturing companies: Alphaduct Company, American Conduit Manufacturing Company, Scranton Button Company, Steel City Electric Company.

W. T. McDOWELL, 51 Liberty street, New York city, has accepted the agency for the Besseltric lighter. This is a cigar lighter from which 1,500 lights are guaranteed for one cent. The lighter consumes three-fourths of an ampere of current during the actual process of lighting. The apparatus is substantially made and ornamental in appearance, and may be attached to any Edison socket, and hang in a convenient place over the counter.

JAMES BEGGS & COMPANY, 109 Liberty street, New York city, has issued a handsome catalogue describing the Blackburn-Smith feed water filter and grease extractor. This filter is for the removal of organic matter, sediment, lubricating oils, etc., from boiler feed water and for the removal of any matter in mechanical suspension in liquids where economy or quality of product is affected by the presence of such matter. Among the subjects treated in this catalogue are the effect of oil on the boiler, utilization of condensed water from heating systems and condensers, methods of treating feed water, and the removal of oil from condensation. The company will be pleased to send this catalogue upon request.

THE GREEN FUEL ECONOMIZER COMPANY, Matteawan, N. Y., has issued a pamphlet entitled "Drying Materials in Industrial Plants." This takes up the drying of various materials, such as fabrics, clothes, malt, lumber, baking powder, paper, paper pulp, sugar, etc. Besides describing and illustrating the fans, blowers, steam coils, etc., manufactured by this company for use in drying plants, an interesting account is given of the philosophy of drying and the text is illustrated by drawings and photographs of drying plants for many different purposes. This pamphlet also describes the Green air heater, which utilizes the waste heat in the flue gases from boiler or other furnaces for heating and drying purposes.

Record of Electrical Patents.

Week of July 23.

860,627. SECTIONAL INCANDESCENT LAMP. George E. Bill and Albert D. Redman, Sr., Harrisburg, Pa. A lamp with a plurality of filaments.

860,647. COIN-COLLECTING APPARATUS FOR TELEPHONE EXCHANGES. Claude D. Enochs, La Crosse, Wis., assignor to Western Electric Company, Chicago, Ill. A collecting apparatus controlled by a signaling circuit.

860,726. SURFACE-CONTACT ELECTRIC RAILWAY. William M. Brown, Johnstown, Pa., assignor to the Lorain Steel Company. An electromagnetic system.

860,771. APPARATUS FOR PURIFYING WATER. Alfred O. Tate, Brooklyn, N. Y. The water is treated electrolytically.

860,791. MOISTURE-PROOF ELECTRIC MOTOR, DYNAMO, AND THE LIKE. Frederick W. Ells, Milwaukee, Wis A moisture-absorbing material is placed within the motor casing.

860,813. DYNAMO CONSTRUCTION. Henry Leitner, Woking, England. Subsidiary magnets are provided.

860,860. MULTIPLE-STATION TELEPHONE SYSTEM. Arthur J. Farmer, Detroit, Mich. An electromagnetic switching device.

860,861. TELEPHONE CABLE-TERMINAL. Edward C. Flory, Santa Barbara, Cal. A distributing box for cables.

860,867. ELECTRIC-LAMP SOCKET. Thomas H. Hill, Philadelphia, Pa. The key is rotated by a ratchet wheel.

860,874. RINGING AND LISTENING KEY. Herbert L. Knight, Cleveland, Ohio, assignor, by mesne assignments, to Century Telephone Construction Company, Buffalo, N. Y. A pivoted operating lever attached to a frame with laterally extending insulating parts.

860,902. TELEPHONE-EXCHANGE SYSTEM. Edward E. Clement, Washington, D. C. A method of charging telephone exchange batteries.

860,907. AUTOMATIC CUTOUT. George Eastham, Chicago, Ill. A cutout controlled by centrifugal force.

860,920. LOCK-OUT DEVICE FOR TELEPHONES. Daniel W. Kneisly, Dayton, Ohio. The instrument is provided with a selector.

860,945. APPARATUS FOR RAILWAY SIGNALING. Henry W. Spang, New York, N. Y., assignor, by mesne assignments, to Charles H. Ketcham, Yonkers, N. Y. The signaling circuits are connected to a short rail section.

860,948. SAFETY DEVICE. George G. Wacker, New York, N. Y., assignor of one-half to Gabriel L. Schiesser, New York, N. Y. The air-brake system on the trains is controlled electrically by the position of the semaphore.

860,953. DYNAMOELECTRIC MACHINE. Robert B. Williamson, Norwood, Ohio, assignor to the Bullock Electric Manufacturing Company. The brush-holders are mounted on braced arms.

860,961. METER. David Broido and Walter H. Lubach, Berlin, Germany, assignors to General Electric Company. A commutator meter.

860,972. APPARATUS FOR CONTROLLING THE MOTOR AND DRIVING MECHANISM OF SELF-PROPELLED VEHICLES. Lucius T. Gibbs, Hempstead, N. Y. The variable-speed gear is controlled by electromagnets.

860,976. SYSTEM OF CONTROL. George H. Hill, Schenectady, N. Y., assignor to General Electric Company. A train control system.

860,979. DYNAMOELECTRIC MACHINE. Arthur C. King, Madison, Wis., assignor to Northern Electrical Manufacturing Company. The pole-pieces are of soft steel with hardened faces.

860,981. ALTERNATING-CURRENT MACHINE. Marius C. A. Latour, Paris, France, assignor to General Electric Company. A commutator motor.

860,987. ELECTRIC METER. William J. Mowbray, Brooklyn, N. Y., assignor to General Electric Company. An induction meter.

860,998. CONTROLLING ALTERNATING-CURRENT MOTORS. Charles P. Steinmetz, Schenectady, N. Y., assignor to General Electric Company. A series-parallel control system for repulsion motors.

861,001. VISUAL SIGNAL AND KEY. Kelley M. Turner, New York, N. Y., assignor to General Acoustic Company. A telephone signal.

861,003. PROTECTIVE DEVICE FOR TRANSFORMERS. Edward A. Wagner, Fort Wayne, Ind., assignor to General Electric Company. A spark-gap is submerged in the insulating oil.

861,004. DIAL SWITCH FOR REGULATING TRANSFORMERS. Herbert I. Washburn, Overbrook, N. J., assignor to General Electric Company. A locking device for controlling the regulator motors.

861,012. ALTERNATING-CURRENT MOTOR. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Company. A commutator motor having high resistance leads laid in the armature slots.

861,018. SWITCHING MECHANISM FOR ELECTRIC RAILWAYS. Ed W. Clark, Coalton, Ohio. An electrically operated track switch.

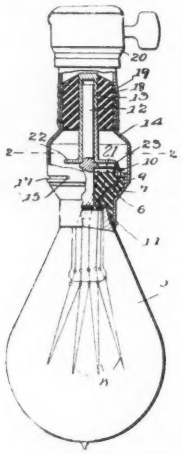
861,029. TRANSFORMER CORE. Walter A. Hall, Lynn, Mass., assignor to General Electric Company. A core composed of separate branches, having longitudinal ribs.

861,031. ELECTRIC INDUCTION-FURNACE. Johannes Härdén, London, England, assignor to the Gröndal Kjellin Company, Limited, London, England. A polyphase current furnace.

861,063. INSULATOR AND SUPPORT FOR ELECTRIC LINES. Theodore Varney, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. An insulator for catenary suspension.

861,064. STRAIN INSULATOR. Theodore Varney, Pittsburg, and Christian Aalborg, Wilkinsburg, Pa., assignors to Westinghouse Electric and Manufacturing Company. A steady strain insulator.

861,071. STRAIN INSULATOR. Christian Aalborg, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. A block insulator.



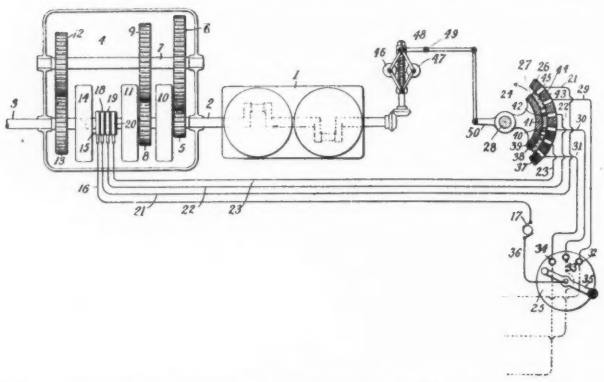
860,627.—Sectional Incandescent Lamp.

861,072. DYNAMOELECTRIC MACHINE. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Company. The armature has two coils per slot, the leads being arranged to produce equal leakage reactances.

861,073. TRANSFORMER. Claxton E. Allen, Lynn, Mass., assignor to General Electric Company. The longitudinal ribs in sections of the core intermeshed to form a solid leg.

861,095. ATTACHMENT FOR RAIN GUTTERS. Louis H. De Limon, Metairie Ridge, La. A tube insulator.

861,097. APPARATUS FOR APPLYING INSULATION TO ELECTRIC CONDUCTORS. Louis W. Downes, Providence, R. I. A device for supplying fibrous insulating material to conductors



860,972.—Apparatus for Controlling the Motor and Driving Mechanism of Self-Propelled Vehicles.

861,100. ELECTRIC CONDUCTOR. Charles E. Eveleth, Schenectady, N. Y., assignor to General Electric Company. A conductor terminal.

861,105. JIG OR FORM FOR COMMUTATOR ASSEMBLING. Henry E. Genor, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. A base-plate with projections holding the segments.

861,117. ELECTROGALVANIC APPARATUS. Frederick F. Hespe, West Hoboken. A galvanic cell.

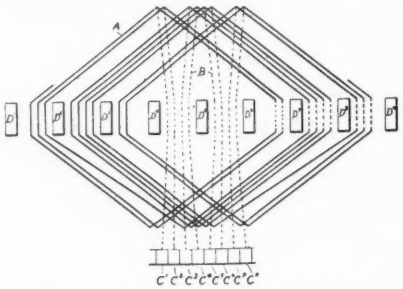
861,125. SIMULTANEOUS TRANSMISSION OF TELEGRAPHIC AND TELEPHONIC IMPULSES. Isidor Kitsee, Philadelphia, Pa. The cable is constructed so as to have a large static capacity.

861,126. TRANSMISSION OF INDUCED IMPULSES. Isidor Kitsee, Philadelphia, Pa. Sharp electrical impulses are produced, and converted into line signals of relatively great endurance.

861,135. ELECTRIC ANNEALING FURNACE. Albert L. Marsh, Lake Bluff, Ill., assignor to the Hoskins Company, Chicago, Ill. A resistance heater.

861,149. STRAIN INSULATOR FOR ELECTRIC LINES. Theodore Varney, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. An insulator consisting of a metal tube provided with insulating caps having taper holes.

861,155. SYSTEM OF ELECTRICAL DISTRIBUTION. John W. Achard, Philadelphia, Pa., assignor to the Electric Storage Battery Company, Philadelphia, Pa. A battery charging switch.



861,072.—Dynamoelectric Machine.

861,162. ELECTRIC BELL. Charles C. Cadden, Cleveland, Ohio, assignor to Century Telephone Construction Company, Buffalo, N. Y. A method of construction.

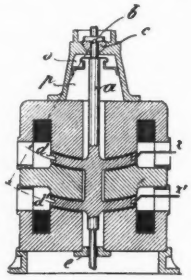
861,192. UNIPOLAR DYNAMO. Wilhelm Mathiesen, Leutzsch-Leipzig, Germany. The armature and poles have spherical faces; the former are carried on a vertical shaft by means of a universal bearing.

861,197. SYSTEM OF MOTOR CONTROL. August Sundh, Yonkers, N. Y., assignor to Otis Elevator Company, Jersey City, N. J. A distance-control system.

861,224. PROCESS OF PRODUCING FERROSILICON. Edgar F. Price, Niagara Falls, N. Y. A silicon compound, mixed with carbon and a source of iron, is smelted in an electric furnace.

861,225. PROCESS OF PRODUCING SILICOSPIEGEL. Edgar F. Price, Niagara Falls, N. Y. Compounds of manganese and silicon, carbon and a source of iron, are smelted in an electric furnace.

861,226. ELECTROLYSIS. Giovanni Rambaldini, Grosseto, Italy. Three electrolytes of different specific gravities are employed.



861,192.—Unipolar Dynamo.

861,233. AUTOMATIC TROLLEY-POLE. Hugh W. Fellows, Cahuenga, and Ira A. Cammett, Hollywood, Cal. A catch prevents too rapid motion of the pole.

861,238. ATTACHMENT-PLUG. William C. Tregoning, Cleveland, Ohio, assignor to the Tregoning Electric Manufacturing Company, Cleveland, Ohio. A method of construction.

861,239. CONTROLLING SWITCH. Harold E. White, Schenectady, N. Y., assignor to General Electric Company. A rotary controlling switch.

861,242. CAN OR RECEPTACLE FOR STORAGE BATTERIES. Thomas A. Edison, Llewellyn Park, Orange, N. J., assignor to Edison Storage Battery Company, West Orange, N. J. The top of the can is so welded that it can be removed.